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ABSTRACT

This summary of a meeting of the Apple Education Advisory Council, on long range technology plans at the state, county, district, and school levels, includes highlights from group discussions on future planning, staff development, and curriculum. Three long range technology plans at the state level are provided: Long Range Educational Technology Plan for California Schools; Learning Technologies and Telecommunications in New York State; and The Use of a Computer To Help Teach the School Curriculum (Minnesota). A county level plan from the Sonoma County Office of Education and a school level plan from the Cincinnati (Ohio) Country Day School are also provided, as well as district level plans from the Palo Alto (California) Unified School District, the Los Angeles (California) Unified School District, and the Keene (New Hampshire) School District. The texts are supplemented by various charts, diagrams, and illustrations, and some references and other resources are listed by individual plans. (EW)

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Long Range Technology Planning

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Learning Tomorrow

Apple Education Advisory Council:
Long-Range Technology Planning

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The Apple Education Advisory Council

Dear Reader:

Welcome to the second issue of Apple's education journal, *Learning Tomorrow*. We're delighted to share new information on education and technology with you.

These monographs are the result of one-day Education Advisory Council (EAC) meetings at Apple Computer. The EAC is a group of experts from education and industry that meets to address topics of concern in education and technology. Each meeting has a different topic, and therefore a different membership. The format of the publication will reflect those changes.

This issue results from the second EAC meeting, which focused on "Long-Range Technology Planning" and was held at Apple's Cupertino, California headquarters on March 20, 1986. Other issues covered in *Learning Tomorrow* include: "Teacher and Administrator Training in Technology," "Multimedia in Education," and "Networking."

We hope you find *Learning Tomorrow* informative, and encourage you to suggest topics for future meetings.

Sincerely,

Sueann Ambron

Sueann Ambron, Ed.D.
Managing Editor

Introduction

Long-range technology planning was selected as a topic for an Education Advisory Meeting because of the importance of planning for effective use of technology in education. Long-range technology planning is a process where staff development and hardware and software acquisition are determined by the curriculum. The process includes assessing what technology is available now and what will be needed in the school during the next three to five years, then writing a plan that will address these needs.

The purpose of this document is to provide educators with a useful resource for long-range technology planning. The document is divided into three sections: group highlights from the EAC small-group discussions, sample long-range technology plans, and a bibliography.

Group Highlights

Participants in the second Apple Education Advisory Council meeting were divided into three discussion groups, which addressed the issues of future planning, staff development, and curriculum. Following are highlights of the group discussions along with advice for those people working on long-range technology plans for schools.

Future Planning
The direction of technology and education involves planning at the strategic, developmental, and operational levels. There is a need to consider multiple scenarios, necessary resources, and trends. Technology in education is an evolving process; changes are constant, and often subtle.

- Long-range planning could consist of preparing a "visibility" document that includes discussion of funding and public relations, or a "future planning" document that is fine-tuned on a regular basis. Lack of vision would prevent future planning.

- Long-range planning is difficult and can be expensive, but it must be faced. Planning for new technologies must address what to do with the old technologies, and how to deal with the new.

- Planning is influenced by social, economic, and technical trends. There is a tension between planning for funding and implementing the plan; for example, how do we make technology invisible and still get money for it?

Advice for school districts/states regarding future planning:
1. Long-range planning is absolutely necessary and demands strong leadership. Planning requires a full-time commitment, and should be done by a heterogeneous group of people with a vision.

2. Planning should allow for maximizing opportunities, and not just produce a product. Planning results should be made public: in order for the plan to be implemented, everyone needs to know there *is* a plan.

3. The fact that the teacher does not need to be a technologist to use technology effectively in education should be made clear in the planning process. Planning for technology in education needs to be updated continually.

4. Partnerships with the economic community, including business, vendors, publishers, and software developers, need to be established.

5. Provisions for staff development should include new teaching strategies that will allow the curriculum to drive the utilization of existing software and the development of new software.

6. There needs to be easy access to appropriate software for teacher review. Software licensing at an institutional level needs to be available.

7. In addition to the factors affecting curriculum—economics, society, and technology—equity issues relating to student access at school and/or home also affect curriculum planning.

8. Preservice education at universities must take technology in education seriously, and prepare students to be able to use technology as an effective learning tool.

Staff Development

1. Staff development provides opportunities to change the way we go about educating, moving away from lecture-dominated instruction. As part of this, the group recommends that technology be used to teach about technology. For example, video technologies, which can reduce the labor costs involved in staff development, are very effective in teaching.

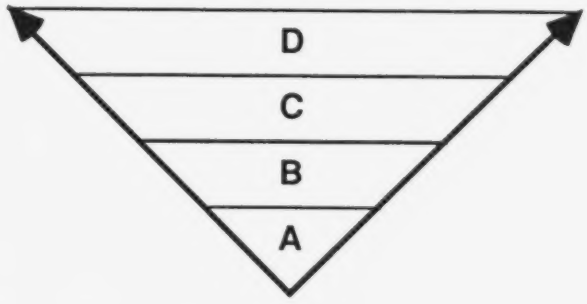
2. Administrative training should not be overlooked. Principals need to be targeted so that they will be more supportive of staff development regarding technology.

3. Teachers need tool kits: word processors, data bases, test makers, and the like. The district staff development coordinator should provide support, and the necessary hardware and software should be accessible for practice.

4. Promote a network of teachers helping teachers. Changes will come from a team approach, not from individuals working in isolation. Provide recognition as well as incentives, and rewards, such as salary stipends and/or hardware, for learning skills related to technology.

Curriculum

The curriculum group discussed the concept of curriculum development as an evolutionary process.



- The first level, (A), is learning *about* technology: what is commonly referred to as *technology literacy*.

- The second level, (B), is learning *with* technology. This usually involves the use of technology to enhance the existing curriculum content. Some examples would be computer-assisted instruction (CAI), computer-managed instruction (CMI), and computer-supported instruction (CSI).

- The third level, (C), is learning *through* technology. Productivity tools come into use to revise the curriculum and promote higher-level thinking skills. Through the mastery of technological skills there can be an empowering of the "whole brain."

- The final level, (D), provides *lifelong learning through* technology. New technologies will be available, and will continue to expand and develop, for the society as a whole to access whenever appropriate.

Advice for school districts/states regarding curriculum:
1. Formulate curriculum planning and share a vision by recognizing the benefits of the higher-level uses of technology (Levels C and D) and the liabilities of the entry-level uses of technology (Levels A and B).

2. Curriculum planning provides the opportunity to clarify/redefine the purpose of education. Expand the involvement of various groups—from grass roots to top management—in the planning process, to enhance the system of leadership.

3. There is a need to have leadership with "vision" to address the problems of dollars, commitment, and time. Finally, accountability must be built into the commitment of those dollars.

Long-Range Technology Plans

Long-Range Technology Plans

The following section contains actual long-range technology plans of various educational organizations at the state, county, district, and school levels. These plans demonstrate the wide spectrum of approaches taken toward technology planning, as well as illuminate the different concerns of state, county, district, and school leaders. Grouped together, the plans offer a comprehensive view of long-range technology planning as it is used in education today.

State Level Plans

Long-Range Educational Technology Plan for California Schools

Prepared by the Educational Technology Committee (Chapter 1133, Statutes of 1983) and submitted to the Superintendent of Public Instruction for consideration by the Superintendent of Public Instruction and the State Board of Education, October 23, 1986.

Adopted by the State Board of Education
November 14, 1986

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I. Introduction

Purpose for This Long-Range Plan
The primary purpose of this Educational Technology Long-Range Plan is to provide a guide for state and local education administrators, teachers, parent and community groups, business leaders, and others who are interested in planning and implementing technology-infused educational programs. The plan is intended to influence the design of services in school and classroom environments in order to promote a general consistency of use of educational technology across the diverse regions and school settings in California.

Major Needs Facing Education: Educational Reform in California
The need for reconstructing and revitalizing America's educational system has been documented eloquently by many recent reports and studies, including, "A Nation at Risk," "Who Will Teach Our Children," and most recently, the report of the Carnegie Forum, "A Nation Prepared: Teachers for the 21st Century." These documents detail a variety of critical issues that are magnified in California because of the enormous scope of the state's educational enterprise.

One of the common themes that these documents address is the need to upgrade the quality of the school curriculum and our standards regarding not only the content, but also the processes that all students should be expected to master. These national reports recommend that we undertake significant efforts to provide teachers with the skills and commitment to address these changes. They also suggest that the basic content of the curriculum must be revitalized in order to provide students with the educational tools to be successful citizens and workers in the 21st century.

The use of educational technology can contribute to programs designed to address these critical needs. Technology-based instructional materials are significant to achieving an upgraded core curriculum. Indeed, as the availability of technology increases, significant changes in the curriculum are likely to occur. Technology-based "distance learning" services can be utilized to assist in comprehensive staff development programs needed to support a new generation of 100,000 teachers, which will be recruited in the next five years. Electronic bulletin boards and data mangement systems specifically designed for school use can help administrators and teachers handle routine, time-consuming, administrative, and management tasks with a high degree of efficiency.

These are only a few examples of potential support that educational technology, introduced in a carefully planned manner, can contribute to educational reform efforts. This plan provides goals, objectives, and strategies that are designed to improve California's educational system in significant ways, ways that will likely result in "schools of the future." However, it must also be recognized explicitly that the planned integration of technology into the schools and classrooms should be undertaken in a manner that is consistent with state and local curriculum improvement efforts. This plan does not assume that technology-based programs alone will address the complexity of needs faced by schools throughout the state.

II. The Educational Technology Local Assistance Program

During the past three years, the Legislature has demonstrated its belief that technology and technology-based curriculum materials should be infused into the educational system in support of comprehensive educational reform. In 1983, the Legislature enacted Assembly Bill 803 (Chapter 1133, Statutes of 1983) which authorized an expanded Educational Technology Assistance Program. During the same year, the Hughes-Hart Educational Reform Act formally established the California network of Teacher Education and Computer Centers and noted that teacher training must include an emphasis on the effective use of technology. Since 1983, financial support for these efforts has increased substantially and these state funds now provide a significant base of support to help schools take advantage of technology-based resources to improve their instructional services.

Legislative Program Mandates

In adopting AB 803, the Legislature specified several essential intentions for the new Educational Technology Local Assistance Program. These mandates provide important philosophical parameters for the use of electronic technology in education. They are: Coordination: There should be a coordinated basis or structure for all segments of the public education system to respond to the needs of California's population.

Business and Industry Involvement: All segments of public education should seek to involve the industrial sector, where such involvement will serve to enhance the responsiveness of technology-based education to the needs of students.

Preparation of Students for Employment: Education should lead to remunerative employment for our youth; and to do so, California students need strong reading, math, science, and technological skills. Public education should prepare a technology-literate work force to meet projected and even unanticipated labor needs for business and industry.

Equity: All California students will have equitable access to instructional programs which provide these skills.

General Principles

In addition to these legislative mandates, the Department of Education, in conjunction with the Educational Technology Committee, a state advisory committee established by AB 803, has implemented several new programs under the auspices of the Educational Technology Local Assistance Program. To ensure that limited state funds would have as wide an impact as possible, several program mangement principles have been adopted. These also serve as important meters for the long-range implementation strategies presented below. They are:

Technology as an Educational Tool: Teachers in all grade levels have demonstrated effectively that electronic technology can be a powerful instructional tool in many learning situations. As a result of these experiences, a basic assumption inherent throughout this Long-Range Plan is that teachers and students will acquire basic technologial literacy through systematic use of technology throughout the instructional program. Even more important, the use of electronic technology as an important instructional tool throughout the curriculum will contibute to the development of important life-long learning skills such as the ability to communicate in writing, techniques for acquiring and managing information and data, and the use of problem-solving strategies to make and test hypotheses.

Basic and Advanced Technologial Literacy: Our graduates need to be technology-literate, not only to become successful wage earners, but also to take advantage of an ever increasing array of technology-based tools used in their daily lives. As noted above, in the near future, students will acquire essential basic technology in instructional programs. At the same time, secondary schools should offer motivated or specially skilled students the opportunity to complete more advanced courses that emphasize the development of specialized skills, such as computer programming using more sophisticated languages and eletronic systems design.

Planning for Educational Technology: At both the school and district level, administrators and teachers, along with interested business and community "partners," must undergo specific planning processes in order to ensure effective use of new educational technology resources. The introduction of technology can and should have a significant impact on the classroom environment. Therefore, teachers must be prepared to make conscious changes in how they manage their classrooms and their lessons, how they organize their students, and how they interact with their students during the day.

School Control and Commitment: At the school level, the faculty must be given responsibility for planning and implementing the use of educational technology resources. As is true with other reform efforts, state-funded educational technology programs must be organized to allow teachers, individually and in groups, to utilize technology in ways that are relevant to their classroom styles and the instructional needs of their students. This flexibility is essential, so that teachers can develop a strong personal commitment to making new programs successful.

Program Leadership Strategies

The process of transforming the classrooms of today into learning centers of the future will require a variety of state and local initiatives that are clearly focused and implemented in a carefully coordinated manner. In California, two leadership strategies are essential in order for the Long-Range Plan to be implemented effectively. These strategies are:

State, Regional, and Local Partnerships: Because of the magnitude of the investment needed and the potential impact on all parts of the educational system, a collaborative partnership-building effort must involve a wide variety of regional and local support agencies. Thus, a major leadership strategy will emphasize support for the systematic development of partnerships, involving both public and private groups, to address each of the six program components in this plan. Specific area partnerships will focus on initiating support for the technology-intensive demonstration schools. Regional partnerships will be needed to support extensive school-level initiatives possible through small-scale grant programs, such as the existing Educational Technology Adoption/Expansion Grant Program. Many such partnerships already exist; others will need to be formally created.

State Educational Technology Funding—a Catalyst to Enhance Existing Resources: Funds allocated for the total Educational Technology Local Assistance Program are not intended to be sufficient for accomplishing the goals of this Long-Range Plan. Thus, a second strategy will be to utilize funding mechanisms which provide the most cost-effective services possible and which take advantage of additional resources, from both public and private sources. This cooperative strategy will be essential in obtaining extensive resources needed to support the network of technology-infused demonstration schools, for regional technical assistance partnerships, for curriculum and staff development efforts, as well as for expanding extensive school-level efforts already underway using existing LEA resources. Business and industry support, fostered by developmental grants, will be an essential part of the overall implementation of this Long-Range Plan.

III. Implementation of a Comprehensive Educational Technology Program

This part of the plan describes the six program components which provide the structure for implementing the Educational Technology Long-Range Plan:
Component 1: Technology-Infused Demonstration Schools
Component 2: Leadership
Component 3: Staff Development
Component 4: Instructional Materials
Component 5: Hardware
Component 6: Facilities

Each of the six program components includes a goal, background statement, objectives, and implementation strategies. While presented as separate components to provide a structure for implementation strategies and commitment of fiscal resources, each component is integrated with the others.

Component 1: Technology-Infused Demonstration Schools

Goal: To develop technology-infused demonstration schools to evaluate the appropriate use of technology in site management, instructional materials, and delivery of instruction.

Background

Expansion of electronic technology has progressed at an explosive pace during the 1980s. The rate of computer hardware development alone substantially exceeded the ability of the instructional and administrative process to keep pace. One now can predict with a high degree of certainty the development of an integrated information center with video, audio, and text presentation capabilities, united under control of a central processor. This presents the exciting possibility of developing learning stations which can simulate the student-teacher interaction of a one-on-one or small group environment.

By 1991, such systems likely will have available, at a minimum, high-capacity storage devices, high-resolution touch screens and interfaces for interactive video, CD–ROM players, "mice," drawing tablets, voice input and voice recognition, and other appropriate technologies. Operating under control of a management system which would routinely perform today's many administrative tasks, such a system could offer efficiencies in learning and instructional management far beyond what has been achievable with past technology. Indeed, the foreseeable possibilities in educational technology of the 1990s will encourage the rethinking of the educational process as we know it today.

At the same time, the simple availability of this array of sophisticated technology will not guarantee its effective use in education, much less its cost-effectiveness, without careful planning, extensive staff development, and systematic implementation processes. Educational policymakers, administrators, and especially teachers, will have to be convinced that such resources can be utilized to enhance the learning environment in many diverse communities in order for them to justify the costs, both financial and personal, involved in undertaking a major transition to technology-based educational systems. The effectiveness of such systems, and the capacity of schools to adopt them, must be demonstrated convincingly in order for such changes to occur during the next 5 to 10 years.

Objectives and Strategies

Because of the magnitude of the investment involved and the potential impact on the educational system, this effort to develop technology-infused demonstration schools will have a number of interrelated components. Each of these is stated as a separate objective in order to provide a means for assessing the degree to which each is implemented; however, all four components must be integrated carefully for this long-term effort to be fully successful.

By developing a network of technology-infused demonstration schools, the state will:

- Demonstrate the practical use of diversified technology-based resources which support the state's overall curriculum reform effort.
- Determine what types of administrative and logistical systems are needed to manage technology-infused schools.

With the assistance of cooperating regional agencies, such as the Teacher Education and Computer Centers (TECCs), Instructional Television (ITV) Agencies, and County Media Centers, the state will:

- Assess what kinds of staff development services are most effective in assisting school faculty to utilize technology-based resources across the curriculum.
- Determine what type of technical assistance services are needed to support a school-in-transition on a concentrated, long-term basis.

With the support of a research and evaluation team, the state will:

- Measure the impact of the total program on student achievement and other measures of change.
- Assess the impact of the total program in terms of organizational and curriculum changes used by the school to implement a technology-based instructional program.

With the assistance of regional centers, higher education, and the participating schools, the state will:

- Establish a comprehensive dissemination plan in order to assist interested schools to implement their own technology-infused curriculum programs.
- Provide systematic research results to policymakers throughout the state to assist them in determining whether resources should be provided for similar programs to be implemented on a wide scale.

Component 2: Leadership

Goal: To provide a long-range vision and to stimulate broad commitment to the achievement of a comprehensive implementation plan which promotes utilization of technology as an effective education tool

Background

California has a large and influential "grass roots" movement of teachers who have begun to utilize technology in the classroom. The group represents a base of support for building a comprehensive educational technology program in California. At the same time, because of the diversity throughout this "grass roots" movement, a clearly stated common sense of purpose is lacking. To be of assistance, business and industry, as well as higher education institutions, need a foundation through which to provide their potentially substantial resources in a far more cost-effective manner.

Similiarly, for educational technology to begin to have a extensive impact in enhancing learning opportunities for students, there must be a knowledgeable, influential group of leaders at all levels of California's educational system. These leaders, from California's schools and school boards, to the State Board of Education, and the State Legislature, must be convinced that the use of technology in education can have an important, positive impact on students and can be managed efficiently by thousands of teachers.

In addition, there must be sufficient state fiscal support available to serve as a catalyst to enable districts to provide training and acquire technology-based instructional materials and hardware. With a foundation in place, schools will have the capability to utilize numerous other resources which can be productivity channeled into the school environment in a positive manner. Certainly the availability of state funding alone will not guarentee that schools and teachers will implement effective programs or that cooperative partnerships with business and industry will proceed on a regional level. But without sufficient state funding, the opportunity to draw on and utilize other resources in a comprehensive program will be unlikely.

Objectives and Strategies

The primary purpose of state leadership will be to foster comprehensive district programs which also include support from industry, higher education, regional educational agencies, community groups, and especially parents. To accomplish this, the State Department of Education, with the advice of the State Educational Technology Committee, will continue to solicit appropriate funding needed to assist local educational agency efforts to develop a foundation of hardware, software, and skilled administrators and teachers needed to implement technology-enhanced classroom programs. State funding will also be necessary to support regional agencies in order that essential technical assistance services are available to assist districts in effectively planning for and introducing technology-based programs throughout their schools.

There are four major leadership objectives:

- The state's fiscal commitment for a comprehensive educational technology local assistance program will be maintained.
- Local assistance fiscal policies and support services networks will be structured to promote careful school planning and to encourage the implementation of cost-effective instructional and administrative programs which emphasize the use of technology to improve the learning environment for all students.
- A comprehensive technology-based communications system will be implemented in order to give administrators, teachers, and students cost-effective, rapid access to diverse information resources, and to facilitate the overall process of informed decision-making in schools throughout the state.
- School support services, emphasizing long-term staff development and in-depth technical assistance services, will be provided to schools through cooperation with a variety of regional agencies, higher education institutions, specialized professional curriculum organizations, and business and industry education partnerships.

The Department of Education will utilize the following strategies to accomplish these objectives:

- Maintain ongoing communication with the State Board of Education, fiscal agencies, and legislative leaders to provide statistical data and evaluation materials which document the results of the local assistance program.
- Develop a long-range telecommunications pilot program to provide school faculty and students access to interconnectable information exchange services and to determine what types of information resources are useful in a comprehensive curriculum reform process.
- Based on extensive advice from educational technology experts, establish and refine local assistance program guidelines which encourage:
  - Comprehensive school-level planning
  - Maximum use of diverse local resources, public and private
  - Continuing reassessment of new technology which can improve student learning
  - Systematic phase-in of new hardware in conjunction with staff training
  - A continuing exchange of ideas and information essential in California's decentralized educational system
- Provide fiscal resources to support regional services, particularly those emphasizing staff development and curriculum planning, that are responsive to the diversity of needs that exist across the state. These regional agency services, including partnerships with higher education and business and industry, are an essential part of the educational reform process that must occur in every classroom in order to have an impact on every student.

Component 3: Staff Development

Goal: To assist teachers and administrators to develop skills needed to incorporate the effective use of technology across the curriculum.

Background
Within the context of educational reforms now being initiated in California, the need to improve the skills of teachers and administrators is a primary concern. Teachers are being challenged to raise the academic standards of their curriculum and to develop more effective techniques for managing classes which are composed of students who are increasingly multiethnic and who have significantly different styles of learning. To highlight the magnitude of the task ahead, a new generation of teachers and administrators, numbering as many as 100,000 by 1990, must be recruited, properly prepared, and introduced into these increasingly complex school environments.

High-quality educational technology resources are already available to enhance virtually every area of the school curriculum, along with powerful tools to assist administrators to strengthen existing school management and evaluation systems. For these to be used effectively, all school staff members need to acquire an appreciation of the positive impact that this diverse array of technology-based resources can have, and to develop the skills necessary to use these resources efficiently and effectively. As colleges of education undertake plans to align their preservice training programs with curriculum reform, the opportunity exists to integrate technology into classes addressing specific content areas as well as instructional methodology in general. As regional agencies, districts, and individual schools develop in-service programs to revitalize teachers' skills and methods, it will be essential to include effective, long-term, easily accessible support services that reinforce new teaching strategies and new curriculum approaches.

Objectives and Strategies
In a state the size of California, a wide variety of well-designed in-service programs are already available for teachers and administrators, many of which utilize partnerships involving university faculty, regional agency curriculum specialists, and experienced teachers. Clearly, these programs should be a major part of a comprehensive effort to assist teachers and administrators to incorporate technology-based resources into their curriculum reform efforts. To implement a comprehensive staff development effort, four major objectives have been established:

- Ensure that teachers graduating from teacher preparation institutions have sufficient knowledge and skills to use technology-based resources effectively in the classroom.
- Ensure that training programs conducted by regional agencies and higher education organizations incorporate technology-based resources as an integral part of their curriculum and delivery strategies.
- Organize alternative models of technology-based training to determine which are responsive to the varying needs of districts throughout the state.
- Ensure that a large number of schools have the necessary resources to enable teachers to participate in training programs according to locally determined plans to integrate technology across the curriculum.

To accomplish these objectives, the Department of Education will give primary emphasis to the following strategies:

- Assist the Commission on Teacher Credentialing to establish regulations and guidelines for coursework necessary for the clear credential to promote the competence of new teachers in using technology in their curriculum.
- Assist institutions of higher education to integrate course content developed as part of the summer technology training institutes into regular preservice programs.
- Through direct fiscal support and the distribution of other technology-based resources, assist regional agency programs (for example, TECCs, ATCs, ITV agencies, county media services) and other staff development networks (such as, California Writing and Math Projects, California Council for Economic Literacy) to provide in-depth training and ongoing technical assistance responsive to the needs of school faculty in their regions.
- Develop and evaluate alternative training models in cooperation with appropriate agencies and organizations, such as:
    - Intensive summer residential institutes with year-long follow-up collaboration of participants
    - Short-term intensive curriculum integration seminars to address critical teaching needs (such as advanced science) and organizational change issues, including training in computer science and advanced technologies
    - Client-specific training programs, particularly for administrators, using regional centers
    - On-site workshops conducted by demonstration schools and effective curriculum integration projects
    - "Distance" extension-type courses and seminars for a widely dispersed audience, particularly those located in rural areas, utilizing two-way audio and visual technologies
- Provide small scale grants directly to districts and schools, which will allow teachers to take advantage of training programs which address their specific needs in an appropriate manner.

Component 4: Instructional Materials

Goals: To assure the development and distribution of the highest quality technology-based instructional materials, including video programming, computer software, interactive video, and printed support materials, in all areas of the curriculum and at all grade levels in a cost-effective manner

Background

Just as there is a need for sufficient quantities of appropriate hardware there is a critical need for high-quality technology-based instructional materials for all areas of the curriculum and at all grade levels. (It should be noted that the term "technology-based instructional computer materials" in this section, and throughout this plan, includes computer software, as well as video and videodisk programs, and utilizes all modes of presentation.) More sophisticated instructional materials using a wide variety of hardware appear on the market daily. Although there have been significant improvements in the quality of technology-based instructional materials recently, there are still "holes" in the curriculum for which no adequate programs exist, and for which it does not make sense to use technology.

Moreover, few, if any, developers support program development to the extent that it reflects state-of-the-art use of technology, as well as what is currently known about instructional design. This is due primarily to the market risks inherent in such development. That is, not only are research, development, and marketing costs extremely high for such an approach, but the return on investment would be almost impossible to estimate, because of the uncertainty of demand for a presumably high-cost package of materials.

It is important for the state to take an active role in this area, if only to illustrate to the software and programming industry the nature and quality of what educators would like to see developed. California is the largest educational market in the country and, as is the case with textbooks, clear direction from the state can have enormous influence on what is produced. It is essential that a proactive strategy be established and carried out to influence the development of high-quality technology-based materials that are carefully integrated with the curriculum of the schools.

Finally, the quantity of technology-based instructional materials is increasing dramatically. Administrators, curriculum, specialists, and teachers throughout California do not have the resources to determine the quality of all these new products, much less the time to incorporate them into their curriculum in an effective manner. Using a structured evaluation process with specified standards of quality, the state can minimize review costs and produce curriculum resource guides and classroom instructional models which highlight the key features into a comprehensive, rigorous core curriculum.

Objectives and Strategies

To meet the goal of promoting greater access to the highest quality technology-based instructional materials, four major objectives have been established:

- Ensure that technology-based materials, especially computer software and video programming, are aligned with the core curriculum to enhance student motivation and achievement.
- Ensure the development of several prototype models of technology programs to illustrate to developers the nature, scope, and quality of programs needed to take full advantage of technology as an instructional tool.
- Ensure that all schools are knowledgable about high-quality materials and how these materials can be integrated with existing course materials.

• Maximize the access of high-quality technology materials to all schools at the lowest possible cost through participation in national buying cooperatives and delivery systems.

To accomplish these objectives, the Department of Education, in close cooperation with business and industry and with regional technical assistance agencies, will undertake a long-range set of strategies:

• With the assistance of curriculum development specialists, develop and annually review standards and guidelines to be used to evaluate the quality of technology-based instructional materials.

• Establish policies and guidelines to define the role of technology-based programs in California's instructional materials adoption process.

• Through partnerships with appropriate regional and local agencies, develop and disseminate curriculum resource guides and classroom instructional models that correlate high-quality technology-based instructional materials with the California curriculum frameworks.

• Establish curriculum specifications for exemplory computer software, video programming, and videodisk materials and develop selected products through partnerships with business and industry partners.

• Participate in multistate consortia to develop technology-based systems to distribute programming far more efficiently than is currently possible.

Component 5: Hardware

Goals: To promote acquisition and integration of technological hardware for maximum effectiveness in California schools.

Background

The information explosion facing both teachers and students, now requires school systems to consider carefully what kind of equipment can best provide access to the multiple sources of information needed to enhance a diverse school curriculum. Electronic information systems, properly structured for educational purposes, can provide such access. Within the classroom, the use of technology-based instructional materials now requires new sophisticated equipment that can easily be misused or underutilized without proper planning, planning that addresses the need for realistic classroom logistical strategies, including sufficient maintenance services, and sufficient instructional materials.

Today schools throughout California do not have sufficient quantities of computer and video equipment, nor instructional materials, needed to implement comprehensive technology-based instructional services that can effectively support the classroom curriculum. In addition, the hardware industry continues to develop more sophisticated, efficient equipment at a rapid rate. Because equipment capability and price are likely to be very volatile for the foreseeable future, schools face the challenge of deciding what products to buy, when, and at what price, knowing full well that changes will occur regularly.

Finally, since the "market" for educational technology products will continue to expand, the hardware industry should play a significant role in fostering the development of electronic tools and systems which are designed or adapted specifically for educational use. As new specialized peripheral devices, mass storage systems, computer-managed video systems, and other innovations emerge, the hardware industry and educational planners must be linked together to be sure that the educational system is prepared to use these powerful technologies to enhance the educational environment.

Objectives and Strategies

Because of the decentralized nature of the school system, most hardware acquisition decisions must be made locally. At the same time, in order to promote long-term strategies of value to education, the broader hardware industry must be involved in a more centralized interactive fashion. Thus, the state's objectives and strategies with regard to hardware include separate components; one focusing on promoting effective school use of hardware, the other on maintaining cooperative partnerships with business and industry.

- All schools should develop a "foundation" program in order to acquire at least a basic quantity of hardware; such a program should permit each elementary student access to computer-based instruction at least one hour per week and secondary students two hours per week.
- The hardware industry, in cooperation with educational specialists, will conduct long-range planning and development programs to ensure that new technologies will be utilized effectively to enhance the school curriculum.

To accomplish these objectives, the Department of Education, with the advice of the state Educational Technology Committee, will undertake the following strategies:

- Administer the small grant Adoption/Expansion Program which allows schools to develop individual plans to acquire hardware and implement instructional programs in response to local needs.
- Provide curriculum development grants designed to demonstrate effective use of new technologies as they are introduced, such as mass storage devices, videodisk systems, and peripheral equipment with specialized functions.
- Organize appropriate school-industry partnerships that promote discounts and donations for specific demonstration programs.
- Develop and disseminate guidelines for evaluating the applicability and effectiveness of new hardware in a school setting.
- Maintain ongoing communication with business and industry leaders to promote appropriate research and testing of new hardware consistent with the needs of the educational system in California.

Component 6: School Facilities

Goals: To ensure that school facilities policies support LEA initiatives to construct technology-infused school environments

Background

California schools attempting to integrate new technologies for both administrative and classroom functions have had difficulty in obtaining adequate space, power, and telecommunications capability. Current building specifications for California schools were developed before new space, power, and telecommunications needs were understood. Schools attempting to utilize new technologies have faced a lack of information about the best school and classroom design installation costs. Adequate and flexible specifications for space, power, and telecommunications are necessary for schools to make effective, efficient use of new technology. Technologically smart schools are now being built to house a variety of uses. Their flexibility allows for growth and changes in the use of the facility. Experience in the development and construction of technologically smart schools can assist in the development of specifications for statewide construction requirements of all new school facilities.

Objectives and Strategies

Schools built during the next five years should be constructed in order to permit easy installation and use of new technology that will be essential in preparing students for the demands of the 21st century. To meet this goal, two major objectives have been established:

- Develop statewide school construction specifications which include appropriate space, power, and telecommunications standards needed by technology-infused schools.
- Support adequate state funding necessary to construct or remodel schools which meet these standards.

To achieve these objectives, the Department of Education will initiate the following strategies:

- In cooperation with appropriate business and industry leaders and district administrators, prepare flexible space, power, and telecommunications standards that will be used when districts construct new schools or remodel existing buildings.
- Develop financial incentives for districts that construct or remodel schools according to these new standards.
- Seek legislative commitment to obtain state fiscal resources that support the need to construct schools according to these new standards.

Learning Technologies and Telecommunications in New York State

Action Recommendations

Approved by the Board of Regents on May 24, 1985

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I. Introduction: The Challenge

Modern society is undergoing profound technological and social changes brought about by "the information revolution." The revolution is characterized by explosive developments in electronic information and other technologies and their transformation into complex systems that span the globe. The impact of this revolution affects individuals, institutions, and governments. If individuals are to thrive economically and socially in a world shaped by these technological developments, they must adapt through education and training. The challenge facing us is the need to define new strategies to enable educational and cultural institutions to respond to these changes and to ensure that technological resources, including information conveyed by these means, are equitably distributed.

The Learning Technologies and Telecommunications Action Recommendations proposed in this document for New York State are responsive to the need for renewed quality and standards in our educational system, for the preservation of access to technological resources for all groups, for economic revitalization of the State through appropriate education, and for using the research and investments made in other sectors for the expansion of learning to educational and cultural institutions. The New York State Department of Education is proposing a series of initiatives to meet these challenges. At the same time, these initiatives address the institutional and societal barriers which could prevent technology from serving its vital role in the Learning Society.

The action recommendations are related to three major goals:

Excellence
Interactive learning technologies and telecommunications must be used to achieve quality within our educational system, and the applications must reflect the highest standards.

Equity
Technological resources, including the information conveyed by these technologies, must be available to all on an equitable, nondiscriminatory, and nonstereotyped basis.

Efficiency
Interactive learning technologies and telecommunications must be employed to achieve greater efficiency in the use of educational resources and enhanced professional effectiveness.

It is important to acknowledge that the four major program offices of the department have emphasized the importance of these goals in their recent planning efforts. Therefore, only a brief indication of the implications of the technologies for achieving excellence, equity, and efficiency in the context of these plans and regents' initiatives is presented in this document.

The actions recommended in this document have been derived from a study of key technology issues relating to research, staff development, telecommunications, integration, and quality of multimedia materials. These issues are as follows:

Research and Development
Research and development activities must address the application of the technologies to meet the needs of education, the importance of a variety of means of disseminating information about technology to field constituencies, and the need to conduct systematic evaluation of interactive technologies to ensure appropriateness and effectiveness.

Professional Development
The most important guarantee that the learning technologies and telecommunications will be appropriately integrated within schools, museums, libraries, and other cultural and informational programs, colleges and universities, adult educational centers, and vocational rehabilitation sites is the adequate provision of effective preservice and inservice training to students, professionals, and other staff members. This issue addresses the need to implement effective staff development programs on both the instructional and administrative uses of the learning and telecommunications technologies. Professional development must also include a planning component for the most effective use of learning technologies.

Quality Instructional Materials
There is growing evidence that the current availability of high-quality learning technology materials is inadequate. This issue concerns the need to enhance the quality of learning technology resources and to ensure that there is a close match between curriculum priorities of the State Education Department and the content of computer or other interactive programs.

Telecommunications
Electronic networks have the potential to achieve the goals of equitable and enhanced delivery of educational and cultural resources with increased efficiency and cost-effectiveness. However, the rapid evolution of telecommunications systems, the continual deregulation of rates and restrictions, and the existence of "untapped" capacities, require that greater attention be given to planning a comprehensive telecommunications system to support the educational and cultural enterprise.

Technological Integration
It is necessary to integrate technologies within the content and program areas of the educational and cultural institutions to ensure that they are effectively used. At the same time, new developments in the industry require that the technologies themselves should be integrated to capitalize their collective strength effectively.

The Center for Learning Technologies has two central functions to ensure that the department's learning technology action recommendations are implemented across the major program offices of the department and across the major educational, cultural, and industrial sectors of the state.

First, the center will coordinate the further development and refinement of the department's recommendations and plans by cooperating with the four major program offices. The Intra-Departmental Learning Technologies Task Force will serve as the mechanism for ensuring that all recommendations address the vital needs of department offices.

Second, the center will continue to foster effective alliances between educators and producers in support of regents' initiatives for revitalizing the economy of the state. Concurrently, the center will continue to serve an integrating function by fostering ongoing alliances among the full range of educational and cultural institutions of the state. The Regents Advisory Council on Learning Technologies, comprised of experts representing all of our educating institutions, will serve a major role in this activity.

II. Implications for the learning technologies and telecommunications in achieving the goals of excellence, equity, and efficiency: An overview.

Excellence

The need to promote and maintain high quality and standards in all educational and cultural institutions in New York state is a priority goal of the regents and a focal concern of each program office within the department. The computer, the interactive videodisc, and broadcast telecommunications technologies are important resources for strengthening educational programs and services. The action recommendations proposed in this document support regents' initiatives to strengthen all facets of the educational system.

The role of the technologies in inproving the quality of educational and cultural programs has been acknowledged. However, there is concern that technologies cannot provide solutions to all educational problems. They should not be imposed without sensitivity to institutional and societal barriers. These barriers include the following:

Institutional Barriers

The interactive technologies must be designed for ease of integration into the programs and services of the schools, colleges, libraries, museums, and other educational and cultural institutions. This will be particularly important for educational institutions that might have to adapt curricula, schedules, and classroom organization in order to employ these technologies effectively. In addition, attention will have to be given to the laws and regulations under which these institutions operate.

Inadequate Staff Development

Widespread use of technology will require that teachers and other professionals be trained both in its use and in the production of high-quality curriculum materials.

Lack of Adequate Software

With few exceptions, the quality of software required for schools, libraries, colleges, and rehabilitation programs is limited. The development of high-quality software is critical since the use of technology is directly correlated to availability and quality of such materials.

Skepticism about Long-Term Effects

Educators and other professionals are seriously concerned that the long-term effects of substituting technology for traditional teaching methods are not sufficiently understood.

The department has begun to address these issues through a national effort of the Council of Chief State School Officers, which has indentified and convened state education agency representatives to explore cooperative efforts that reduce the inhibiting effects of these barriers.

Equity

The New York State Education Department has continually supported the need to maintain access to educational and cultural services for all residents of the state. Special efforts have been undertaken to assure equity for certain population groups who have not actually benefited from these resources. The department has proposed continued support of a number of program initiatives to address the special needs of low-income, minority, and non-English-speaking populations, children-at-risk, adult learners, parents, handicapped parents, out-of-school youth, and unemployed adults. The "Regents' Action Plan to Improve Elementary and Secondary Education Results in New York State" urges that curriculum goals and standards apply to all students and seeks to ensure equity in the availability of resources to provide students equal opportunity to reach or exceed standards. The department has also addressed equity concerns in postsecondary education by stressing the issue of increasing the number of economically disadvantaged and minority students and of women who participate in and complete undergraduate and graduate programs in scientific and technological fields. In the area of cultural education, the department has emphasized that full utilization of libraries, museums, historical organizations, and public television and radio will provide equity of access to information in an age when increased opportunity may depend on this access. Finally, the department has recommended continued support for programs and services that assist physically and mentally disabled persons to acquire a capacity for productive work through Independent Living Centers and other similar programs.

The department is aware of the inequities of access to learning technologies related to low-income, has collected data that can inform policy, programs, and legislative action, and will immediately pursue action (see Recommendation #11) to address this discrepancy and monitor progress toward its elimination.

Efficiency

The need to ensure efficiency in the use of educational resources and greater effectiveness in general within our educational and cultural systems is a national concern and priority goal of the department. Interactive technologies are both an important educational resource and a means of achieving enhanced efficiency.

The New York State Education Department is committed through each of its specific recommendations to (1) employ interactive technologies, such as electronic data-base searching, office automation, networking, and teleconferencing, to achieve greater efficiency, (2) use these technologies efficiently, and (3) foster the implementation of the technologies to support the department goal of providing a significant and vital contribution to improving New York State's economic vitality through its educational and cultural institutions.

III. Goals and Action Recommendations

Excellence
Goal: To employ learning and telecommunications technologies in support of enhanced standards and quality for New York's cultural and educational institutions by supporting the major plans for education in New York state, such as the Regents' Action Plan to Improve Elementary and Secondary Development of Postsecondary Education in New York State, 1984, Comprehensive Plan for the Office of Vocational Rehabilitation, and The Regents' Long-Range Plan for the Office of Cultural Education.

Action Recommendations
Recommendation 1:
The department will develop a process for creating a learning technologies and telecommunications research and development agenda. The agenda developed will serve as a basis for seeking state, federal, foundation, and commercial support for innovative developmental projects as well as operational pilots.

Recommendation 2:
The department will develop a policy and systematic plan of priority "producer/consumer" forums to provide for ongoing participation of department and field staff in the development of learning technology materials in a variety of media formats. The main goal of these collaborative forums is to enhance the quality of materials and systems to ensure a "match" with the content and pedagogical concerns of educators and other professionals at the local, regional, and state levels.

Recommendation 3:
Appropriate department offices will encourage the review of certification programs to determine whether they should be changed to assure that minimal competencies and knowledge about the uses of the learning technologies are included in certification requirements.

This is consistent with the recent recommendation of the Teacher Education, Certification, and Practice Board that "Colleges...include experiences in teacher preparatory programs that will ensure that graduates of teacher preparatory programs are aware of developing technology, able to use it in instruction, and (are) sensitive to its impact on pupils; and to provide staff development for faculty that will ensure a continuing awareness of the impact of technology throughout the teacher preparatory program."

Recommendation 4:
Model learning technology staff development programs will be developed by the department. These programs will be delivered in targeted areas to train a variety of educational and cultural professionals to ensure that the technologies are employed to enhance the standards and quantities of educational and cultural programs. These models will address the competencies and knowledge required for professionals to integrate the full range of appropriate learning technologies within their full respective disciplines and program areas.

Recommendation 5:
The department will develop new alliances and expand current relationships with national, state, and regional organizations to share information about high-quality learning technology opportunities and resources and will develop a long-range agenda of priority collaborative projects to be undertaken with these various organizations. The Council of Chief State School Officers (CCSSO) and the Northeast Regional Exchange, Incorporated (NEREX) are representative examples of organizations with whom the department has cooperated on technology initiatives.

Equity
Goal: To ensure that technology, its applications, and instruction in its use within education are available to all on an equitable, nondiscriminatory, and nonstereotyped basis.

Action Recommendations
Recommendation 6:
The department will focus learning technology and telecommunications efforts on institutions in need, such as school districts with high drop-out rates and those in the lowest-ranking 10 to15 percent on the Pupil Evaluation Program Tests in reading and mathematics and the preliminary competency tests in reading, writing, and mathematics. It will seek to apply technology for teaching adult basic skills in order to improve the ability of libraries, colleges, and other institutions to serve the educational needs of low-income, minority, or disadvantaged populations.

Recommendation 7:
The department will work with hardware and software producers to address the development and introduction of computer peripherals and software that will enable the physically handicapped, the learning disabled, and the developmentally delayed learners of New York state to gain access to learning technologies and use them effectively.

Recommendation 8:
In order to increase access for all to training programs, including those programs that are curriculum-oriented and designed to end stereotyping and sex biases, the department will work with appropriate field organizations in the development of appropriate staff development programs. This will also include the development of training models capable of replication throughout the state with a focus on institutions serving low-income or minority populations.

Recommendation 9:
In order to access and monitor the efforts to achieve a more equitable distribution of learning technology and telecommunications capacity, the department will:
- Implement a planned agenda of survey research related to telecommunications and local video and computing capacities to determine needs and provide summary data reports to support the development of bias-free learning programs and to access distribution of interactive learning resources.

• Immediately implement an annual data collection procedure to monitor the progress of actions targeted on achieving equitable access and applications of the learning technologies and telecommunications capacities.

Recommendation 10:
Arrangements for statewide volume price discounts for quality learning technology hardware and software will be undertaken by the department to provide greater access for all of New York's citizens to these technologies.

Recommendation 11:
To help ensure that there is full and equitable access to the technologies for all, the department will recommend new or amended legislation for 1986–87 that (a) addresses enhanced access to the technologies (hardware, software, and telecommunication capacity) and (b) increases the ability to apply them effectively through provision of targeted staff development, planning, and technical assistance for low-income school districts, postsecondary institutions, and other low-income and minority populations.

Efficiency
Goal: To promote efficiency in the use of resources and greater effectiveness in general within educational and cultural systems through the implementation of appropriate learning and telecommunications technologies.

Action Recommendations
Recommendation 12:
The department will expand its capacity for identifying and transferring appropriate and promising technological developments and applications from the military, industrial, and nonprofit sectors that have implications for enhancing the efficiency of New York's educational and cultural institutions. This will be accomplished via the identification of exemplary programs and the transfer of these and other emerging technologies and developments from other sectors.

Recommendation 13:
Legislation and regulations will be proposed to encourage private-sector investment in learning technology products and services that directly benefit the educational and cultural programs of the state. The following principal activities will be considered:
• The introduction of tax incentives to stimulate private-sector investments and appropriate software and hardware development (including resources for research and development).
• The development of policy and procedures related to copyright protection of software and other easily copied forms of media and materials used for research instruction or instructional-support purposes.

Recommendation 14:
The State Education Department will seek additional legislative support for the provision of financial incentives to enable educators and other professionals to take advanced training and pursue project development activities related to the integration of the technologies for increasing overall efficiency within their respective fields. The types of training and in-service activities that need to be addressed should include, but not be limited to, the following:

- Advanced training and project development activities designed to support K–12 teachers and college faculty in the use of interactive program effectiveness.
- Orientation and training programs specifically designed to support enhanced instructional management requirements of the Regents' Action Plan.
- Provision of advanced training for librarians, museum specialists, and media specialists in the use of technologies such as library automation, telecommunications, networking, and video applications, for enhanced efficiency in the delivery of service.
- Provision of programs specifically designed to train the providers of instructional services to special needs populations (for example, handicapped, vocational rehabilitation, corrections, gifted) in the use of appropriate learning technologies to enhance the efficient delivery of learning experiences and educational/cultural resources to these groups.

Recommendation 15:
A comprehensive study must address current and planned telecommunications capacities and the implementation of a telecommunication network that might be used by all state agencies in a cost-sharing arrangement. Also, the department will continue to pursue a close relationship with state and local telecommunications efforts, such as those of the Urban Development Corporation, to ensure high-level, comprehensive state telecommunications study and planning.

IV. Next Steps

These goals and action recommendations provide a context for the department to begin a process of reviewing current activities and developing specific initiatives and time lines for their implementation.

This process will occur through the Education Department's Technology Task Force and the Regents' Advisory Council for Learning Technologies. Every effort will be made to focus on initiatives that have cross-department implications and to identify specific actions in order to inform budgetary and legislative considerations for the 1986–87 fiscal year.

The process leading to the development of these recommendations has provided significant direction for overall department action relative to learning technologies and telecommunications. It has also clarified and refined the role of the Center for Learning Technologies as serving the following department functions relative to the further evolution of a comprehensive department technology and telecommunications program:

- Learning technologies and telecommunications policy coordination, legislation review, and interagency relationships to ensure they take into account the goals and issues identified.
- Coordination of collaborative relationships within the department and with external profit and nonprofit organizations.
- Provision of requested technical assistance relative to purchase and planning for the application of appropriate technologies.
- Provision of staff development and development of models to enhance professional competencies in the use of effective technology in educational and cultural settings.
- Dissemination of information related to new and emerging technologies and their implications for education, research, and exemplary applications.

These functional responsibilities are consistent with the original charge to the center. They have been refined over the last two years and take on a new vitality in light of the recently approved plans of the department's four major program offices.

Department program offices began preparing legislative program recommendations and budget and work plan recommendations for FY 1986-87 in May, 1985. These offices include implementation for both the goals and the recommendations in this department plan within their submissions to the Board of Regents, and a summary document representing these department initiatives has been prepared.

The Office of Elementary, Secondary, and Continuing Education will emphasize:

- Development of policies, procedures, and monitoring activities to ensure that learning technologies are available to all elementary and secondary students on an equitable and nondiscriminatory basis.
- Use of learning technologies, particularly productivity tools, to improve achievement within each curriculum area.
- Use of learning technologies in staff development activities for department and school personnel throughout the state.
- Improvement in the use of telecommunications in school management and instructional delivery systems.
- Review of appropriate technologies for use in student testing.
- Identification, evaluation, and dissemination of promising applications of technology in education.

The Office of Higher and Professional Education will emphasize:

- Necessary learning technology skills required of those seeking teacher certification.
- Enhancement of training in the learning technologies at Teacher Resource and Computer Training Centers and other preservice or teacher training programs.
- Increased support for the purchase of equipment and networking for research and instruction.
- Funding of cooperative efforts electronically linking academic and research libraries with one another and with other libraries to promote a wide range of access to resources.

The Office of Cultural Education will emphasize:

- Use of information technologies to improve the existing interlibrary loan and communications systems, connecting academic, public, special, and school libraries.
- Use of interactive and information technologies for the development of regional cultural networks to support scientific and cultural research efforts in the state's museums, libraries, archives, and historical societies.
- Development and application of technology to serve public television, radio, and educational cable services in both program delivery and management.

The Office of Vocational Rehabilitation will emphasize:

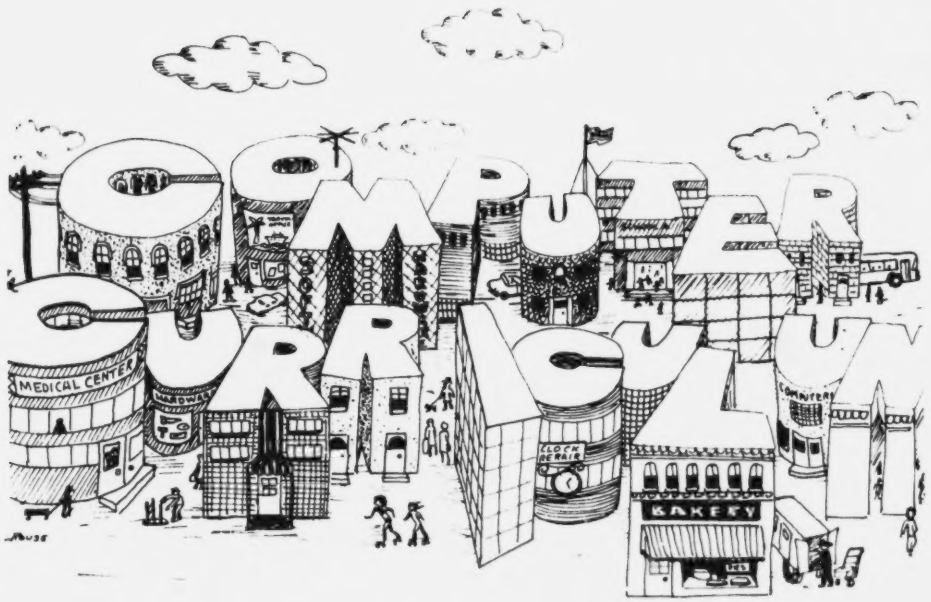
- Advancement of adaptive technologies to enable individuals with disabilities both to learn and to participate in competitive employment.
- Use of information technologies in order to expand the employment opportunities for the homebound disabled.
- Application of technologies and telecommunications to enhance efficiency and effectiveness of research and service delivery.

The regents will have the opportunity to judge each of the applications of the learning technologies against the department plan when they approve their state legislative program and budget requests on an annual basis.

Compilation of Considerations Regarding

The Use of a Computer to Help Teach the School Curriculum

A Joint Project of:
Minnesota Association for Supervision and Curriculum Development
Minnesota Association of School Administrators
Minnesota Department of Education



Committee Members

This document was developed through the cooperation of the Minnesota Association of School Administrators, Minnesota Association for Supervision and Curriculum Development, the Minnesota Department of Education, and individuals noted for their interest in and knowledge of computers. The document was developed in response to needs identified by the three organizations.

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Introduction

What is the Purpose of this Document?
This document is designed to be used by any school person (teacher, administrator, school board member) in a position to make decisions for a district about the future use of computers. It illustrates a systematic way of defining curriculum, selecting software, selecting hardware, developing materials, and then implementing the materials chosen. This document will serve as a guide for making informed and logical computer decisions.

As many professional staff members as possible should be included in the decision making. The process outlined in this document lends itself to the committee approach.

This document is not intended to be the final authority on computer decisions. It is intended to serve as a structure from which a district can draw conclusions and make final decisions that are appropriate for that district's individual needs. In addition to the decision-making structure, this document contains numerous references and resources where additional help and expertise can be obtained.

How do you use this document?
There are several parts to this document, none of which should be used in isolation or overlooked.

Districts making decisions of this significance should move logically and should progress step by step through the process outlined in this document. Subcommittees may study an individual section; however, every effort must be made to integrate all parts into a whole. Prior to any decisions on hardware, the appropriateness of the curriculum decision must be established. The addition of computers (hardware and software) into a program setting is first and foremost a curricular decision.

The logical decision-making sequence should be as follows:
1. Appropriateness as addition to the curriculum
2. Appropriateness of available software or decision on local development of software
3. Availability of hardware to accomplish the curriculum intent
4. Process for successful implementation into the curriculum

Why was this document produced?
Because of many external factors, including the rapid development of technology, it becomes imperative to provide educational opportunities for students that enable them to fulfill their potential and to adjust to a changing world. A decision to delay until "new technology" is developed, because you believe that what you might purchase now may soon be obsolete, will be a disservice to your students. The basic tenets of computer literacy will remain fairly constant and can readily be adapted to changing technology.

While computers are not a panacea, they do provide alternatives for a school district. They provide options for a labor-intensive budget, and they allow for different strategies in curricular areas, including enrichment, remediation, low-enrollment courses, and so on.

The instructional use of computers must be integrated into the "grand design for instruction" commonly called the curriculum. The reasons to utilize computers are to enhance one's learning and knowledge base. Use of the computer gives the teacher and the learner another tool to accomplish this purpose.

What additional resources are available to help implement the document?
Minnesota is fortunate in that various sources of assistance are available to school districts. Some of these sources and contact people are:

Council of Quality Education (CQE) Computer Project Directors
See listing in bibliography section, or call Sue Sattel: 612-296-5118

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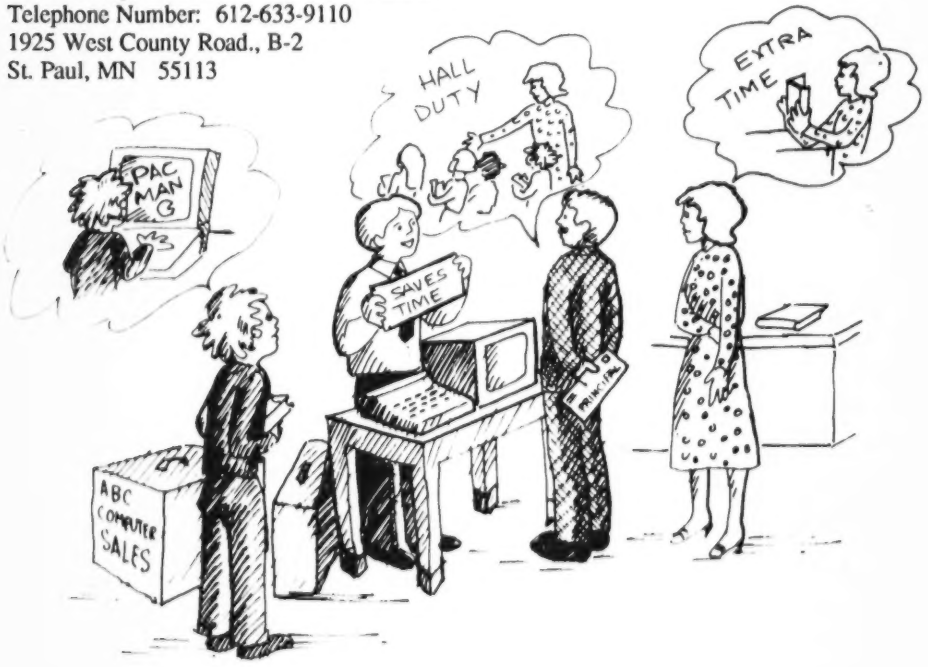


Section I: Curriculum Considerations

The considerations included in this document are intended to help educators utilize computers in teaching the school curriculum. Underlying all the considerations are two beliefs. The first is that school districts need to use a systems approach to curriculum development and implementation. A systems approach to curriculum considers interacting educational issues or concerns to form an appropriate educational plan. The plan, however, is not static but rather dynamic and continues to be recycled to insure that the plan provides optimum results. Readers are referred to the "Responsive Education" model on page 2. In this section the focus is on general curriculum development and implementation regardless of the subject or delivery system. The second belief is that computers need to be considered as another instructional tool/delivery system, superior in some situations and inferior in others. The intent of this document is to improve instruction and not to promote computer use.

Curriculum in this paper is defined as a written document which is a plan for the education of pupils during their enrollment in school and which will clarify what will be taught, when it will be taught, and in the ways it might be taught. It also improves the teaching process by providing teachers with supports such as assessment and evaluation items, appropriate bibliographies and resources (and, in some cases, with sample activities).

There are numerous reasons for developing a curriculum. Some of the most important are:

1. To clarify for students, staff, and community, the mission of the school and the essentials of the district's total curriculum.

2. To define what learner outcomes/objectives teachers have responsibility/accountability to cover.

3. To define for teachers what learner outcomes or objectives are appropriate for students at different developmental levels.

4. To define how a particular curriculum is to be organized to reduce unproductive repetition and important content voids.

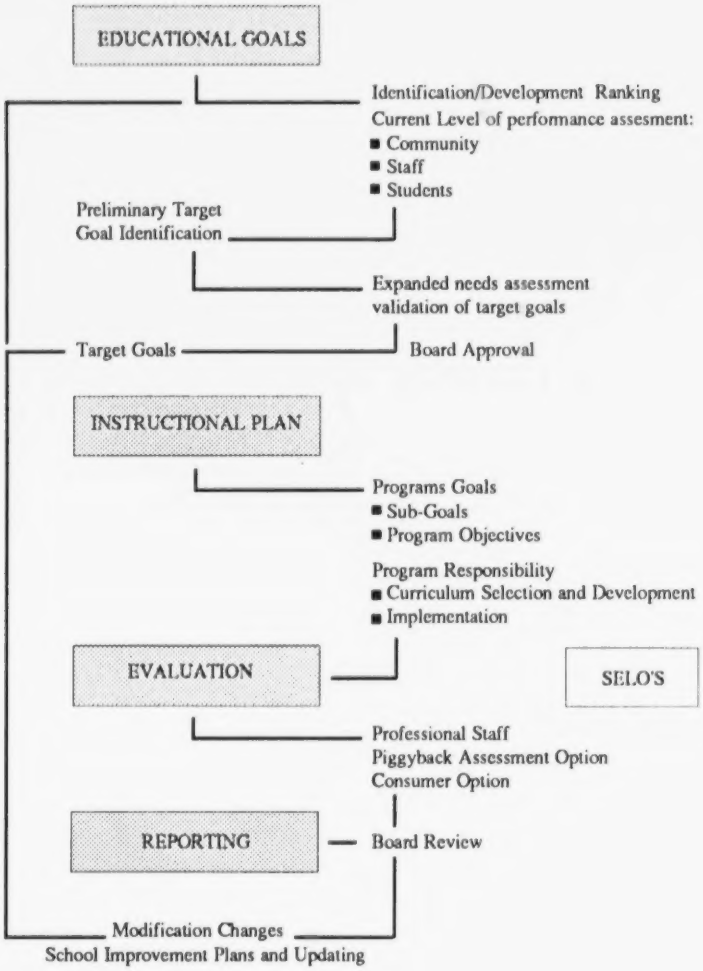
5. To maintain reasonable consistency within a district's offerings so that students are able to receive approximately the same content in various sections of an offering.

6. To establish a common base from which local educators, individually and in a group, can plan for instruction.

7. To identify useful resources that teachers might use to teach specific outcomes and thus enhance the quality of instruction and reduce preparation time.

8. To help integrate learning in the various disciplines.

A curriculum development and implementation system has many formats and designs. The following model has been adapted to practices used in Minnesota. Specifically it has been designed to accommodate the Planning, Evaluation and Reporting (P.E.R.) Law. As the "Responsive Education" model indicates, curriculum development and implementation is perceived within the context of four general headings. Those four headings are: (1) Educational Goals, (2) Instructional Plan, (3) Evaluation, and (4) Reporting. Each of these headings has many elements and requires detailed attention.



Educational goals evolve from an educational philosophy that defines general expectations in different areas of a student's life. Very often school districts use goal formats already developed by organizations and then modify and priortize as is appropriate for them. The Phi Delta Kappa and the Association for Supervision and Curriculum Development goals/subgoals are two sets widely used. It is extremely important to have parent and student participation in the ranking of the goals. Additionally, schools need to consider assessment information derived from tests and other sources of data, such as follow-up studies and questionnaires. In short, great care needs to be given to validating what general expectations there will be for students and educators.

Educational goals, however, provide only general direction. Student learner outcomes on program goals are necessary for determining with more specificity what will be taught (scope), when it will be taught (sequence), and how it will be taught (instructional strategies). These three components are the major elements of an instructional plan. Learner outcomes are usually developed within the framework of a goal or, more often, by subject/discipline areas. Learner outcomes in a well-developed curriculum indicate the concepts students will learn in a given area. They are specific enough so that parents will understand what their children are to learn. Those same learner outcomes are expecially important for determining unproductive duplication and for finding gaps within a subject and among different subjects. Considerable attention needs to be given to insuring that cognitive, attitude, and skill outcomes are specified for each major concept and that the curriculum has balance, relevance, and unity. Educators should also consider whether their curriculum accommodates different learning styles and motivation preferences. Additionally, developers need to be certain that all levels in a learning taxonomy are covered and that there is not an over-reliance on recognition and recall of facts.

Evaluation is the third major consideration in a systems approach to education. Evaluation generally has two lines of consideration, program and individual. Program evaluations are concerned with the effectiveness of instruction to a group, while individual evaluation is concerned with the progress of one student. There are two major types of evaluation at the two levels. Formative evaluation is concerned with ongoing events. This type of evaluation is used to make ongoing corrections, modifications, or adjustments as a means of improving the learning effort. Summative evaluation is an overall look at the effort so as to determine whether the individual as well as the program may be characterized as successful. If at all possible, new curriculum development efforts should be pilot-tested so that problems which arise affect only a small group and can be minimized when working with a larger population.

Reporting is the fourth major consideration in a "responsible education system." There should be concern with providing information that is usable to all groups. Parents and students should understand the general process undertaken at each stage, and the conclusions should be noted in language that is not overly technical or heavy in educational jargon. Educators should receive clear information about which program components need to be modified and which are working well. They also should have sufficient information to determine whether all populations are being served adequately.

If a systems approach to curriculum is in place, then computer activities will likely be more appropriate elements of the school curriculum. A curriculum system increases the possibility that computer activities, and in fact all activities, are part of a defined educational plan—and not merely unrelated activities, which take time but do not help to accomplish specific goals.

Curriculum Review Checklist
This checklist is appropriate for general curriculum regardless of subject matter or delivery system. In the next section, specific consideration is given to the potential of computer delivered curriculum.

Curriculum will be defined in this paper as a written document that is a plan for the education of pupils during their enrollment in school. Curriculum clarifies what will be taught, when it will be taught and the ways it might be taught, and indicates how people will know whether the educational effort was successful or not.

1. Does the document clarify for students, staff, and community, the mission and elements of a district's total curriculum?

2. Does the document have a process for verifying that what is being offered is important and worthwhile, and that it meets state requirements?

3. Does the document offer a plan that is realistic in light of resources available, and does it offer a good possibility of success?

4. Does the document allow for:
- Assessment of needs
- Planning
- Implementation
- Evaluation
- Reporting to the public

5. Does the document sufficiently provide for:
- Scope
- Sequence
- Instructional strategies

6. Does the document provide for learner outcomes in the domains of:
- Cognition
- Skills
- Attitudes

7. Does the document suggest several approaches to accommodate a variety of learning styles and developmental needs?

8. Does the school or building document fit in adequately with the district curriculum and educational philosophy?

9. Does the document allow for both:
- Formative evaluation
- Summative evaluation

10. Does the document lend itself, as a good systems approach should, to a variety of activities including computer approaches?

Potential Use of the Computer

Computer utilization encompasses activities ranging from simply responding to highly directed programs to developing totally new methods of utilizing computers in very complex, personally developed ways. School districts, eventually, will need to define their understanding and expectations for computer use. The following list is intended to assist you in examining the potential of computers. However, they are potentials, not necessarily options that exist today, or more cost efficient than current techniques.

A. Some Potential Contributions to Students' Goals

Self-Concept: the computer can allow for
- Working at one's own pace, minimizing failure
- Privacy to make mistakes without peer pressure
- Immediate feedback and a second chance

Problem Solving: the computer can allow for
- Use of the computer as a tool for problem solving
- Specific practice in problem-solving skills
- Programming as a direct experience with logical, sequential thinking
- Emphasized searching for relationships and analogies

Access to New Information/Body of Knowledge: the computer can provide
- Data bases and forecasting tools
- Projection techniques
- Materials for self-instruction

Skills Development/Enhancement: the computer can provide
- Drill and practice
- Tutorial instruction
- Simulation
- Decision making
- Assessment

Attitudes/Values: the computer can provide
- Values clarification
- Career guidance
- Experience with new technology

Technology Literacy: the computer provides opportunity to interact with technology in a learning situation.

Exploration, Experimentation, and Curiosity Encouragement: the computer can provide
- "Discovery" experiences with open-ended programs that students can manipulate
- Simulations to extend opportunities for experimentation
- Opportunities for students to make the computer work for them

Independent Learning Encouragement: the computer can provide
- A source of feedback in addition to the teacher
- Clarification of subjective/objective judgment
- Self-paced, interactive instruction.

B. Potential Contributions to Teacher Goals and Learner Outcomes

Instructional Options: Through computer use, some subject content can be enhanced without excess

- Time
- Budget
- Facilities
- Resources

Student Motivation: the Computer can allow

- Creativity
- Curiousity
- Challenge
- Rational thinking skills
- Self-evaluation of learner outcomes
- Enhancement of interaction and participation with learning
- Variety in reinforcement
- Participation

Immediate Feedback/Initial Reinforcement: Learner interaction is visually displayed: can provide

- Constant reinforcement—learner assessment of concepts
- Challenges to student—(branching development) tutorial or accelerated learning principles

Exploration (Self-Directed): The computer can allow teachers to interact independently with new content or learning principles.

Technology Literacy: The computer provides opportunity to interact with technology in a learning situation.

Diagnostic Capabilities: The computer can provide for

- Concise, comprehensive assessment of students' individual needs
- Evaluation/statistical measurements
- Ongoing assessment and branching to appropriate level of instruction

Individualized Instruction: The computer can provide for

- Assessment of individual needs
- Monitoring of student progress
- Nontraditional learning principles
- Accommodating individual learning difficulties (special needs, handicaps, and so on.)
- Alternatives for course make-up or content emphasis-acceleration (for the gifted)

Flexibility of Learning Methods: The computer can provide for

- Variety in reinforcing
- Drill and practice
- Problem-solving
- Simulation (role-playing)
- Tutorial (self-paced) learning
- Discover learning through specific programs

Expansion of Learning Experience: The computer can provide instruction for low incident enrollment subject matter and equality of certain types of instruction among schools and districts.

It can allow for additional courses not normally offered because of limitations that are due to

- Liability
- Budget
- Facility
- Expertise

C. Potential Contributions to Home Goals

Extended Instruction: The computer can allow for

- Sharing with parents
- Uniformity of homework
- Clear indication that objectives have been mastered

Preschool Instruction: The computer allows for

- Use of readiness activities
- Self-directed instruction
- Quick evaluation of strengths and needs
- Sophisticated work for nonreaders
- Sophisticated work for children with undeveloped motor skills

Home-bound Instruction: The computer allows for

- Student participation when injured or ill
- Use of apparatus to enhance interaction
- Reduction of movement

Productive Use of Leisure Time: The computer allows for

- Activities that have learning potential
- Activities that are safe but exciting
- Equality relative to ability
- Ability of physically smaller people to compete with physically larger people
- Relatively inexpensive programs
- High staying power

Self-Improvement: The computer allows for

- Self-paced instruction
- Individualized interest
- Immediate response
- Accelerated use of materials
- Travel requirement reduction
- Prompting and corrective feedback
- Reduction of age bias
- Low incidence courses
- Experiments that might otherwise be hazardous

Post Secondary Instruction: The computer allows for
- Self-paced instruction
- Individualized interest
- Immediate response
- Accelerated use of materials
- Travel requirement reduction
- Age bias reduction
- Low-incidence courses
- Experiments that might otherwise be hazardous

D. Potential Contributions to Management Goals
As class size increases the computer can help teachers
- Store student data
- Do pretesting and posttesting
- Direct student progress through a program
- Prepare class profiles

When expenditures shift from the general fund to the capital fund, a computer can be purchased instead of textbooks or other teaching aids.

Low-incidence course enrollment increases because students can use a computer with minimal assistance.

Subsystem curriculum management can be used to
- Monitor what is being taught
- Gather data on student achievement

Special-need student groups: The computer can provide for
- Development of an individual education plan
- Assessment of student needs

Staff motivation: The computer gives teachers a new teaching tool.

Curriculum consistency: The computer provides
- Uniform instruction
- Protection against accidental omission

Curriculum record-keeping: The computer allows for
- Gathering data by grade level
- Gathering data by subject areas
- Comparing achievement with potential

Curriculum Efficiency: The computer enables students to
- Can learn some content faster
- Can proceed at a faster pace
- Can experience success

Curriculum system effectiveness increases so that
- Student achievement can be increased
- Objectives can be clarified
- The relevance of content/skills can be learned
- Strengths and weaknesses can be pointed out

E. Contributions that Are Not Possible

A computer cannot replace a teacher's responsibility for diagnosis and prescription.
A computer cannot guarantee that learning will take place.
A computer cannot operate independently, or effectively, without human input.
A computer cannot replace human interaction, either group or individual.
A computer cannot provide adequate auditory or tactile experiences.
A computer cannot <u>care</u> about individual students.

I don't care what it told you, computers do not eat ice cream!

Computer Literacy
The computer is both a tool and a subject of instruction. Schools desiring to teach students to use the computer beyond automatic programs may wish to consider the following concerns as areas for possible study.

Students will be able to discuss and demonstrate:

a. The uses of computers

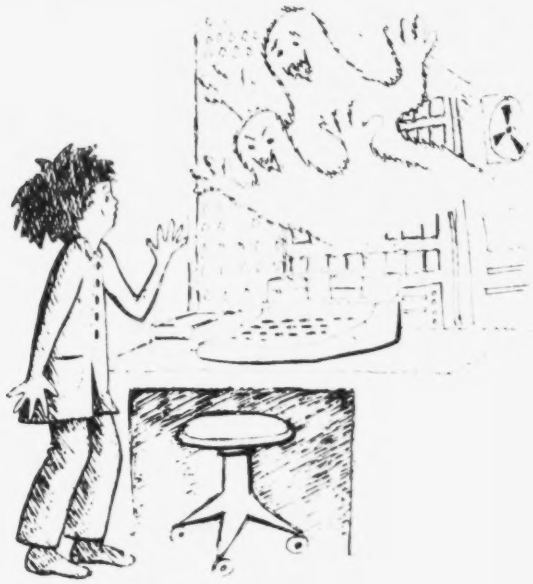
b. The ways computers do their work

c. The theory of programming computers at a basic level

d. Societal implications and limitations of computer use

e. The student should be able to use the computer in some of the following ways:
- To utilize data bases
- To simulate real problems
- To solve problems
- To edit text and perform other word processor functions
- To make decisions
- To convey information in a suitable manner
- To receive instruction

Recognizing the diversity of local schools' needs and priorities, the committee chose not to develop a recommended computer literacy scope and sequence. The committee has located several examples that could serve as models. Readers are encouraged to call the resource people listed on page 44 to obtain the most recent examples.



Section II: Software Selection

Widespread and rapid growth in the number of microcomputers used in Minnesota schools has created a sizable demand for instructional software. This demand is further increased by home users providing educational microcomputer experiences for their children. Private enterprise has responded to these and similar demands with an influx of new software, new companies, and new marketing firms. The marketing firms range from highly reputable to "fly-by-night." Commercial software may range in price from $10 to $895 or more, and the instructinal or technical quality of a program may range from exceptional to poor or inappropriate for classroom use.

In spite of wide quality differences, many educators are hesitant to examine or evaluate software. They feel unqualified because of lack of computer experience or expertise. Although some aspects of this media are new, many are not. Contrary to what some authors of software would have us believe, good instructional design did not originate with the advent of educational computing. "Master" teachers were generating artful, effective lessons and materials long before computers were seriously considered as a potential tool for education. Matching instructional level to reading level, conceptual level to motivational level, and so on (within a single experience or group of experiences), are familiar concerns. An educator wishing to evaulate software should begin with what he or she already knows about evaluating any material or media. One may also wish to use such publications as Handbook for Evaluating and Selecting Curriculum Materials by Meredith Damien Gall (1)* or "Possible Selection Criteria" by Research for Better Schools. (2) Start by learning the unique aspects of computerized materials. A summary of important considerations can be found in the computer software development section of this document. Those wishing more details should look at the original document developed by the Minnesota Educational Computer Consortium (3) and other similarly appropriate materials.

You may also wish to brush up on the elements of instructional design. Principles of Instructional Design by Robert M Gagne and Leslie J. Briggs (4), Curriculum Design and Development by David Pratt (5), and Curriculum Development: A Guide to Practice by Jon Wiles and Joseph Bondi (6) are three of many excellent resources.

Finally, apply common sense and judgment. Don't abandon those practices that have proven successful. Apply standards that promote quality education regardless of media.

Computer Software Selection Checklist
(Note: Combinations of the types of programs listed below are common, so it may be difficult to label some programs as to specific type.)

A. CONTENT—The same considerations apply as for other instructional media.
Overall:
1. Is the content appropriate to your needs? Yes No
2. Does it support your curriculum objectives? Yes No

* More complete references for resources 1-6 are listed in Section VI, Bibliography and Resources.

B. INSTRUCTIONAL DESIGN—Numerous types of programs are available. The following are common examples and some of the concerns of each:

1. Drill and Practice—provides practice for a skill taught previously.
a. Is there a variety of levels of difficulty? Yes No
b. Is additional practice provided as needed? Yes No
c. Does the program provide management feedback—record student performance? Yes No
d. Are positive and negative feedback given, as well as any necessary hints? Yes No

2. Tutorial—conducts actual instruction, generally in the form of a dialogue between the student and the computer.
a. Is there an appropriate amount of interaction? Yes No
b. Is evaluation included? Yes No
c. Can appropriate segments be accessed by the student without going through the entire sequence? Yes No

3. Simulation—generates models of environments, experiments, and so on.
a. Is there a reason for using a simulation rather than actual experience (for example, danger or expense)? Yes No
b. Are opportunities to generalize provided? Yes No
c. Is graphic representation utilized? Yes No
d. Are any assumptions identified? Yes No
e. Is the simulation based on a valid model? Yes No

4. Game—generally includes randomized events, provides an opportunity to "win," and presents some obstacles to "winning."
a. Is the game appropriate to your needs or objectives? Yes No
b. Is it instructional as well as diverting? Yes No
c. Is the student motivated toward learning rather than just winning? Yes No

5. Information Retrieval—Information (data) is generated in the form of lists, graphs, tables, and the like.
a. Is documentation easy to understand? Yes No
b. Is storage capacity adequate? Yes No
c. Is speed of operation or access adequate? Yes No

6. Utility—a support program for the teacher to generate student activities (such as crossword puzzles, word games, individualized spelling or math drills).
a. Is the utility program flexible? Yes No
b. Is it easy to use? Yes No
c. Is it well documented? Yes No

7. Management—record keeping of student performance, which may be an integral part of another program or used alone as a source of diagnosis and prescription.
a. Is it easy to use? Yes No
b. Is format suitable for reporting? Yes No
c. Does it ensure student privacy? Yes No

8. Content—Is the program free of racial/sexual, social stereotypes, inappropriate language, and so on? Yes No

C. Presentation

1. Purpose—Is the intended use—initial instruction, remediation, guided practice, independent practice or enrichment/extension—evident? Yes No

2. Directions—Are they clear to the students? Yes No

3. Objectives—Does the student know what is to be gained by using the program? Yes No

4. Feedback—Is it effective from the students' perspective? Yes No
   a. Does the feedback vary with the performance? Yes No
   b. Does the learner get a correct answer after three or fewer wrong attempts? Yes No
   c. Does the feedback lead to additional learning or merely state "right" or "wrong"? Yes No

5. Display—Is the program visually appealing, attractive, readable? Yes No

6. Ease of use—Can the program be used independently with a minimum of teacher preparation or intervention? Yes No

7. User Control—Does the student have control over rate of presentation? Yes No
   a. Can the student begin the instruction at a level appropriate to his or her ability?
   b. Can the student seek help from the program? Yes No

8. Theoretical Basis—Does the instructional design reflect sound learning theory? Yes No

9. Is the order of presentation logical and sequential? Yes No

10. Have any critical prerequisite skills been identified? Yes No
    a. Is it clear what the student must know or be able to do before using the program? Yes No

11. Intended or Appropriate Audience
    a. Is it clear for whom the program was designed? Yes No
    b. Is it clear for whom it is appropriate? Yes No

D. TECHNICAL DESIGN

1. Is the program "error free"? Yes No

2. Does the program make effective, purposeful use of color, graphics, and sound, or are they used just for "show"? Yes No

3. Does the program adequately provide for misspelled words or variations of responses? Yes No

E. SUPPORT MATERIALS

1. Are the objectives of the support materials clearly defined? Yes No
a. Do they match/complement those of the program? Yes No

2. Is it evident whether support materials are optional or required for proper use of the program? Yes No

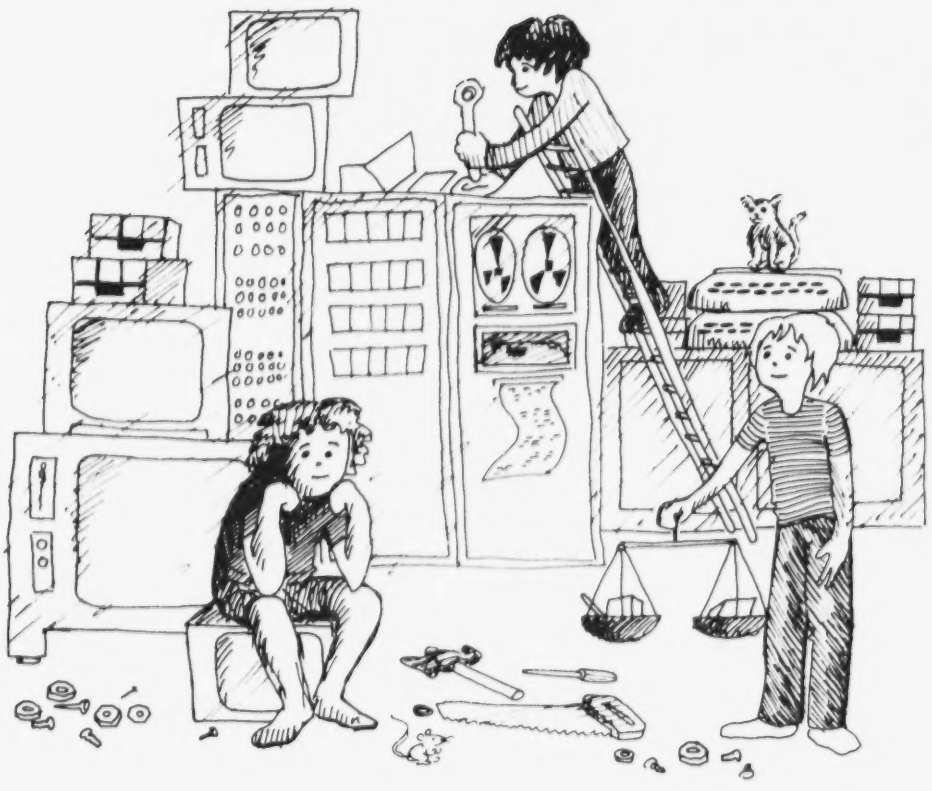
3. Do the support materials provide the teacher with additional background (such as a bibliography or other resources, sample run of the program)? Yes No

4. Are the student materials effective, attractive, appealing, and useful? Yes No

F. EQUIPMENT—have the following factors been taken into account and found acceptable or available? Yes No

1. Appropriate computer? Yes No
2. Language? Yes No
3. Memory? Yes No
4. Disk or tape? Yes No
5. Special equipment such as a printer, light pen, paddles, or joystick? Yes No

Section III: Computer Hardware Selection



The challenge in selecting a microcomputer system (or any computer system) is to select a combination of programs and equipment that will meet immediate and, preferably, future needs. This selection can best be accomplished by working from a set of clear goals. Currently, goals for microcomputer use will fall into three broad categories:

1. Instructional Use
2. Administrative/Management
3. Software Development

A. If the goal is to maximize the instructional potential of microcomputers, planners might consider the following:
1. How many students are to be served?
2. What subject matter will be taught?
3. What grade levels will be included in use?
4. Will the equipment be used in individual classrooms or in a laboratory?
5. How have computer applications been included in the curriculum?

B. If the goal is to use microcomputers in administrative areas, consider:
1. Will the system be used for word processing?
2. Is inventory management a likely application?
3. Is there a need to maintain budget information on the computer?
4. Is sufficient storage available?

C. Software development is a broad goal, which can include many functions. Among them are original programming in a high-level language, instruction, advanced programming for students and teachers, and development of courses using an authoring language. All of the functions which focus on the computer as the subject of instruction could be included in this area. Considerations include:
1. Is the system expandable and flexible?
2. Can you use different high-level languages, such as, BASIC, FORTRAN, COBOL, PASCAL, LISP, and FORTH?
3. Is documentation available which will provide thorough access to the machine's capabilities?

D. Overall, there are general questions applicable to the three preceding areas.
1. Will the system have to accommodate more than one user at a time?
2. Would a selection that meets needs in all areas marginally be preferable to a mix of hardware that meets specific needs well?

Criteria for Computer Selection

The following are suggested features. No one device will contain all features or meet all criteria. Your use of the computer will determine the relative improtance of each.

1. Cost: Microcomputers generally range from $100 to $5,000 or more for a complete system. The cost most often reflects the memory capabilities, mass storage devices (disc drives), and flexibility of the system.

2. Portability: In assessing portability of a system, the following should be considered:
- Is weight excessive or can a utility cart be employed?
- Are special environmental considerations (humidity, dust, temperature) a problem?
- How many components must be disconnected before moving the system?
- Can the system work reliably when moved frequently?

3. Mainframe Interface: Can the unit be interfaced with available time-sharing systems to function as a smart terminal (through a communication card, serial card, modem)?

4. Keyboard Layout: There are unfortunately no standards for computer keyboards, although most are similar to a typewriter. Among the variations are size, number and placement of keys, and special key functions. Several computer keyboards also include special numeric key locations to be used in calculation activities.

If at least 50 percent of usage will involve calculation activities, a keyboard with an auxiliary numeric key pad should be considered. (Numeric key pads are available as attachments at an approximate cost of $80 to $250, depending upon functions.)

5. Additional Ports: Ports are connections or "plugs" which connect the computer to other equipment, such as numeric key pads, modulators, printers, or paddles. Ports may be referred to as I/O ports or input/output ports. Where are the ports located? How accessible are they? If ports are located in an inconvenient place requiring that the system be constantly dismantled, perhaps another system should be considered.

6. Memory Capacity Considerations

RAM (Random Access Memory) is used for workspace in the computer, for temporary storage of programs, calculations, results. The amount of RAM determines the maximum size of programs the computer can accommodate. The minimum useful RAM is about 8 thousand characters (8K), while the preferable amount for most applications is from 48K to 64K.

ROM (Read Only Memory) is useful for storing programs that are used frequently such as BASIC language. This memory is generally programmed by the manufacturer into an integrated circuit chip. The program is stored permanently in the chip. The computer can read the memory but cannot change it. Programs in this form are frequently called firmware.

a. Is sufficient RAM provided to operate the software you have chosen?
b. Can RAM be expanded?
c. Are frequently used programs available in ROM?
d. Can ROM be expanded?
e. Are costs for RAM and ROM expansion within reason?

7. Input/Output Devices: In reviewing the input/output devices, one must determine the capability of such devices.

a. What type of printers are compatible with the system?
b. Is a monitor built in or separate?
c. Must a monitor be used or is a standard television adequate?
d. Are disk drives built in or separate?
e. How many disk drives can the system access?
f. Is the system compatible with a hard-disk drive for mass storage capabilities? What provisions are available for hard-disk back-up?
g. What types of other peripherals are compatible with the system? (graphic tablet, synthesizers, light pens, and so on.)
h. Can system be connected to a video tape recorder (VTR) or a video disk player?

8. Video Display: Video displays may be integrated into the computer or attached as a separate unit.

a. How many characters are available per line on video output? (Video display in most cases is either 40 or 80 characters. For word processing and data management, 80 characters are recommended.)
b. What character sets are available? (Size of text, upper and lower case, upper case only, graphics characters.)
c. Is the system capable of displaying low- or high-resolution graphics?
d. Is the system capable of generating color?

9. Sound Generation: In reviewing sound generation qualities, the following criteria should be considered:

a. Are there internal or external speakers with the system?
b. Can additional external speakers of music boards be added to the system easily?
c. Is the tone or pitch range quality adequate for music generation?
d. Can the system be adapted to voice command or generation with auxiliary peripherals?

10. Documentation: Documentation and support services from the manufacturer or distributor are of great importance in making a final selection. In reviewing materials, the following criteria should be considered:

a. Are there sufficient manuals and support materials for the system?
b. Is the content well presented and easily understood?
c. Are diagrams and step-by-step instructions included?
d. Is the manufacturer/distributor willing or able to answer questions on the phone?

11. Servicing: Service and repair of equipment is another vital concern. Overlooking servicing criteria at the time of purchase and can cause some unnecessary hardships later. For this reason, the following should be considered:

a. What type of warranties are available?
b. What do the warranties include—parts, labor, shipping, and so on?
c. Can school district technical staff be trained to service the equipment?
d. Are training sessions available from the manufacturer?
e. Is training included with purchase or is it available at additional cost?

If the computer must be serviced outside the school district, the following should be considered:

a. Is an on-site service contract available? What are the costs and terms?
b. Is the service center local or remote from the district?
c. Are shipping costs covered?
d. What is average turn-around time for repair and delivery?
e. Are replacement parts readily available?
f. Is a loan program available so lost time can be reduced?

After reviewing the criteria for computer selection, the next logical step is to examine video displays and printers.

Peripherals are often more difficult to evaluate and select than computers.

Manufacturers are constantly producing new peripherals, and the number of variations in standard video displays and printers is astounding. In selecting peripherals, one should make sure that the peripherals are compatible with a particular computer selection and provide the features required for special software applications.

Criteria for Video Display Selection

1. Terminology: Video displays generally range from $75 to $1000. The cost generally indicates: size of screen, black/white vs. color, resolution of screen display for text clarity, color, and graphics.

Several types of video displays can be used in computer applications. One source of confusion is the use of the terms video monitor, video display, or video terminal. All refer to a type of video display for a computer, but each has its own special features.

Video Display: The general term that indicates a device to display video signals from a computer system.

Video Monitor: Similar to a television set, but differs from a standard television in that it cannot receive signals over the air.

Video Terminal: A video monitor equipped with a keyboard and logic circuits for display of characters and graphic information.

2. Alternative Displays: A regular black and white television receiver may be used as a video display. Some computers require an external RF (radio frequency) modulator. An RF modulator is a device that costs approximately $40 and is connected to an I/O port in the computer and the antenna terminals of the television. A modulator will temporarily convert a standard television into a computer display. Although an RF modulator is an inexpensive alternative to a black and white or color video monitor, the screen resolution is somewhat distorted with an RF modulator. Text can become blurry and shadowed, causing unnecessary eye-strain to the user. Readability and clarity of text are not as sharp as other video display alternatives. Check to see that radiation levels from the screen are not excessive.

• If a computer application requires the user to read extensive text, a video monitor should be considered. The second most economical alternative is the black-and-white or green-phosphorus screen video monitor. Average cost for a display of this type is approximately $150. Cost will range from $125 to $350 depending on size of screen and resolution characteristics. Green-phosphorus monitors are generally preferred over black and white for their high quality text display, visual clarity, and reduced eye strain.

Color monitors range from $400 to $1000. The average cost is approximately $450, again depending upon resolution characteristics, size of screen, and so forth.

A color monitor provides better high-quality color definition than a regular television receiver. Color monitors are particularly useful in color graphics displays, but they are not recommended for a great deal of text work (such as business applications or word processing) because of color diffusion and text overlap. For this reason color monitors are not well suited to 80-character line display.

3. Flexibility/Portability: If a video display unit is not built into the computer system, consider:

• What is the weight of the video display device?
• What types of video connectors are required?
• What screen sizes are available—9 inches to 25 inches?
• Are handles available for transportation?
• Are auxiliary input and output connections available so additional monitors can be chained to a single computer?

4. Accessibility of Controls: Location of the various video controls should be reviewed.

a. Are the vertical and horizontal controls easily accessible?
b. If controls are located on the rear of the video display, are they clearly marked and easy to adjust? (Several companies require a special tool or screwdriver to adjust controls on the rear panel.)
c. If controls are located on the front of the system, is a special door or cover available to hide controls when not in use?
d. What type of power switch is available? If a pull-on switch is available, is the knob securely fastened?
e. Is a pilot lamp or power-on signal light provided?

Criteria for Printer Selection

There is a bewildering variety of printers on the market, each with different features, speeds, and interface provisions. But for microcomputer use, there are essentially two fundamental methods for creating letter or graphic symbols on paper. Most familiar is the adaptation and development of the method used in high-quality typewriters. Letters are made by a ball or wheel element which strikes ribbon and paper to produce a clear, fully formed character. Less costly is the dot matrix printer, which forms characters with closely spaced dots. While the characters are easily recognizable and sometimes approach the quality of fully formed characters, only a few dot matrix printers are of correspondence quality. Printers cost from $300 to $5000. The letter quality-printer prices begin at about $1600. This price has been gradually coming down and may approach the cost of a quality electric typewriter in the future.

1. Portability: In assessing portability of the printer, the following should be considered:

a. How much does the printer weigh?
b. How big is it?
c. Does it require special environmental considerations (such as protection from humidity and dust)?
d. Can the printer withstand frequent movement or transporting?
e. How many cables must be disconnected before transporting?

2. Computer Interface:

a. What type of computer interface card is needed? Serial or parallel? Special card developed by the printer company?
b. What auxiliary cords are needed for computer connection?

3. Paper: In reviewing printers, consider type of paper, size, and method of paper advance and entry. If the printer is used heavily, the less expensive printer that uses costly thermal paper may result in higher long-term costs than would have resulted if a more expensive printer had been purchased.

a. Does the printer require thermal, sprocket fed, or regular paper?
b. What is the cost of paper (in bulk quantities)?
c. What size of paper is required—40, 80 or 132 column?
d. Can the printer print on pressure sensitive labels?
e. What is the maximum thickness of paper accepted (suggested paper weight)?

4. Friction-fed printers allow the user to print on letterheads, forms, ditto masters, and regular bond paper. This option is helpful for word-processing operations. Such printers are slower than sprocket-fed printers and may cause some inconvenience to the user.

Sprocket-fed (tractor) printers move paper by advancing the printer sprockets into corresponding holes in the paper. This method assures proper alignment. The operation is very fast and, once the printer begins, no user interaction is required. Tear-away edge on the sprocket-fed paper is recommended when the output will be photocopied.

a. Is sprocket feed only provided?
b. Is friction feed only provided?
c. Does the printer accept both friction and sprocket-fed paper? (This type is recommended for the versatility it provides.)
d. How is paper fed into the machine?
- Bottom feed (requires special stand)
- Front or rear feed (front feed convenient for single sheets)
- Automatic paper feed or manual

5. Speed of Printer: Printer speed refers to the number of seconds it takes to print a group of characters. This rate is expressed in characters per second (CPS). Common speeds are 10, 15, 30, 45, 55, 135, and 225 CPS.

In general, dot-matrix printers are faster than letter-quality printers. If letter-quality is not an important factor, a dot-matrix printer is a good choice for fast, efficient, and reliable printing.

6. Character Sets and Fonts: In determining quality of character sets, the following questions should be reviewed.

a. Is character spacing variable or fixed? If variable, what are the spacings?
b. Is the density of dots forming characters low, medium, or high?
c. Are block or double-width characters available?
d. Is there a double-strike feature for emphasis of headings or titles?

A font is an assortment of type all of one size and style. The more fonts available, the more versatile the printer will be. Some available variations are listed below:

a. Upper case
b. Lower case
c. Condensed
d. Double width
e. Reverse (white on black)
f. Roman, or italic, serif or sans serif
g. Block graphics, fine-line graphics
h. Foreign language symbols, mathematical symbols
i. Range of type sizes

Another feature of the higher quality printers is the storage of alternate character sets in ROM (Read Only Memory). Some printers allow the user to define their own character sets.

7. Operator Control: Operator control refers to the functions of the printer that can be specified by the user. All printers have switches that must be set to determine the printer's functions. In reviewing switch controls, consider the following:

a. Where are switches located? (Switches inside the printer force the user to remove covers to change the switch settings. Switches may be located on the back, front, or side. The front- and side-mounted switches are the most convenient for the user.)
b. Is line-spacing selectable?
c. Are selectable margin settings provided?
d. Is font or character set selectable?
e. Are various computer-to-printer communication rates (baud rate) provided?
f. Is an on line/off line indicator switch provided?
g. Is there a self-test function? (Several printers include a self-test function that allows you to test the internal switches you have set in the system.)
h. Can form switch be set? (Lets the user define the top of the paper for print entry for fan-fold, tractor-fed operation.)
i. Does form feed advance paper to next top of form setting automatically?
j. Does line feed allow user to adjust paper automatically one line at a time?
k. Is manual form alignment possible? (Several printers only have automatic alignment features. Manual adjustments enable the user to control paper as in a typewriter.)

Switch operation and function vary among the types of printers available. The more expensive the printer, the more versatile are the switch selection and font characteristics. Another function is the graphics capability of the system. Graphics are often available for printers as an extra cost option. The size of the character matrix determines the quality of the graphics output. A few printer manufacturers have announced the option of color printing for graphic generation or plotting.

Additional considerations for printer selections should be based on adequate documentation and service contracts. Clear and concise documentation is essential to make full use of printer capabilities provided. In reviewing documentation, a quick reference card for printer switch adjustment and function is a welcome extra.

Service contracts should be a major concern of the user. Printers have more mechanical parts than other microcomputer peripherals and may require service before the rest of the system.

Section IV: Software Development

(Based in part on Designing Instructional Computing Materials* available from the Minnesota Educational Computing Consortium).

There is an increasing recognition of the part computers—especially microcomputers—can play in instruction. Although educational software is available from commerical publishers and computer consortiums, many educators have indicated an interest in developing their own courseware, or in designing material suitable for their own classroom use.

Some consideration of existing courseware which could fulfill the identified needs should occur at this point. Commercial software, MECC, TIES, Title IV, and CQE projects are all sources of existing software which could fit the defined needs of educators. TIES and MECC coordinators can assist you in identifying and previewing their courseware. Title IV and CQE microcomputer projects can be identified by the Minnesota Department of Education and contacted individually.

Commercial software is a more difficult source to utilize. It is almost impossible to preview software unless the company has a local distributor who will lend out the materials. Courseware evaluations are available in journals and in compendiums. Journals which regularly review educational courseware are:

The Journal of Courseware Review
Apple Education Fund
20525 Mariani Avenue
Cupertino, CA 95014

Electronic Learning Magazine
Scholastic Inc.
50 West 44th Street
New York, NY 10036

The Computer Teacher
Computing Center
Eastern Oregon State College
La Grande, OR 97850

On Computing
Box 307
Martinsville, NJ 08836

Collections of courseware evaluations done by educators are:

Micro SIFT
300 Southwest 6th Avenue
Portland, OR 97204

MACUL
Larry Smith
Wayne County ISD
P.O. Box 807
Wayne, MI 48184

JEM Reference Manual
Discovery Park
University of Victoria
P.O. Box 1700
Victoria, B.C. Canada V8W 8Y2

* Designing Instructional Computing Materials, 1981, MECC Publications, 2520 Broadway Drive, St. Paul, MN 55113

If suitable materials do not exist and your district decides to undertake development of courseware, you must examine your available resources. Development is an expensive undertaking in terms of time and money. Estimating costs in either of these areas is difficult and will require close attention by the person who will manage the project.

People resources also must be assessed. A development team should include people with expertise in the following areas:

- Management
- Courseware subject matter
- Courseware design
- Programming

The development process should include classroom-teacher testing and evaluation at both the formative and final stages of courseware development. Therefore, classroom teacher availability and interest must be determined.

If these resources—time, money, and people—are available and the "needs assessment" has been completed, you are prepared to begin development and may find the guidelines in the remainder of this section a valuable reference. You should also keep in close touch with your MECC or TIES coordinators, who may prove to be an invaluable resource.

If these resources are lacking, you may want to consider development on a lesser scale using teacher utility programs or authoring systems. Utility programs, such as MECC and TIES have available, will allow you to set up multiple choice, true-false and completion quizzes that your students can do on the computer. Authoring programs, such as PILOT, take more time to learn but allow you to create drill and practice, and tutorial lesson materials, which can contain graphics and feedback and be highly interactive.

Preparation

The first thing to consider when designing and developing computer courseware is that about 70 percent of what needs to be done is very similar to the process required when developing other curriculum materials. Philosophy, values, goals, and learner outcomes must be defined. Characteristics and needs of learners must be assessed. All people involved need to have a clear understanding of who will do it, when it will be done, what resources are available, why it is being done, how they will know when the project has been completed, and how they will be able to judge its success or failure.

Once a specific product has been "legitimitized," curriculum developers need to make clear linkages to the educational goals and learner outcomes they are addressing. Instructional objectives should be sharpened and the specific concepts, skills, processes, and affective expectations selected and/or defined. Developers, ideally, should provide preinstruction and postinstruction assessment items in addition to making suggestions for content and activities. The learning activities should be flexible enough to allow use by learners of different abilities and learning styles. The content and activities should be designed in a manner that does not require unreasonable demands on resources relative to expected benefits.

Computer courseware development does require some difficult considerations. The remainder of this section will be devoted to an examination of those differences.

Development Process

M.D. Roblyer, in an article titled "Instructional Differences," noted that a major reason why "the majority of microcomputer courseware materials currently on the market is not of acceptable instructional quality" is that technical personnel viewed the production process as programming versus the product as applications software. She correctly notes that instructional design of courseware must be the new emphasis. Roblyer believes that there are four major considerations in establishing an instructional design system:

1. Use of a model
2. Emphasis on a written design document
3. A team approach to development
4. Provision for formative evaluation

The MECC Program (DISC and documentation) "Designing Instructional Materials" acknowledges Roblyer's suggestion for overall planning. Their program, however, is intended to assist people with development of individual products. MECC designed its training program around five topics:

a. Analysis
b. Motivation
c. Interaction
d. Screen layout/graphics
e. Testing and evaluation.

A. Analysis
Before embarking on a specific piece of courseware, teachers should analyze in advance the purposes and objectives they wish to achieve, keeping in mind the above-mentioned use of motivation.

Objectives
1. To determine the objectives of the program
2. To determine the sequence of learning by stating the order of skills to be learned
3. To determine the appropriateness of the microcomputer application
4. To determine which of these skills will be presented on the computer and which will be accomplished by other means, such as teacher presentation of support materials
5. To determine the strategy to be used in presentation

The first step in designing a computer application is the selection of the topic and thus the learning objectives. The next step is to consider instructional design. The following checklist should be kept in mind:

1. State objectives.
2. Decide how courseware will be used in the curriculum.
3. State the skills to be presented and in which order.
4. Determine the appropriateness of the microcomputer.
5. Select a strategy.
6. Review the role of support materials and other media.
7. Design lesson.
8. Test and assess the product.

1. State Objectives
After the topic has been selected, the specific objectives to be achieved should be listed. This list will assist the designer to achieve logical sequential steps in the instructional model. And when the list has thus been divided into parts, it will be easier to decide which pieces of the task can be assigned to the computer. Only after the concept has been analyzed should the specific objectives be written out.

2. How Courseware Will Be Used
Like any curriculum material, instructional courseware must fit into the existing curriculum and its total goals. The specificity of the material as well as its appropriateness for a computer are major considerations.

3. Skills To Be Presented
Designer should arrange the skills in the order they are to be learned. Be aware of the prerequisite skills. Put the easier concepts at the beginning to build the student's confidence. And remember that providing varying degrees of difficulty will enhance the student's success and challenges. Concrete examples should be provided before the abstract ones.

4. Determine the Appropriateness of Microcomputer Application

The designer should select an idea that is appropriate, such as experiments that can easily be done in class. Presentation of large quantities of written material would not be an effective use of the computer. Often a screen full of text material might be presented more effectively in printed form. If the material requires students to discuss or share opinions, the microcomputer may not be suitable. At times, however, the microcomputer can serve as an information device to help students in discussion.

The teaching of the topic should gain in effectiveness through the use of the computer. The microcomputer should "add" to the classroom presentation and not replace something that could be done as effectively or cheaper using another method.

Some ways a computer can add to instruction are:

1. Budgetary—being able to have "actual" experience does not always warrant the cost of needed equipment. Many schools cannot afford the expensive equipment needed for studies in nuclear physics, for example.
2. Time related—many experiences require significant time frames which may not be feasible; population studies, for example, are often prohibitively time-consuming.
3. Risk minimizing—real-world experiences that involve danger may not be practical.
4. Situational—many experiences, like managing a business, cannot be experienced first hand, since businesses would not risk losses just to give a student experience in managing profit margins.
5. Repeatability—many times we wish to repeat experiments exactly. Replication is often impossible in real world situations because of the items listed above.

5. Select a Strategy

The designer must select the type of mode to use. The mode will depend partly on the objective to be achieved and how it will fit into the curriculum.

6. Review the Role of Support Materials

In deciding how the computer material will be incorporated in the curriculum, the role of the support material and other media should be reviewed. How much of the material will be presented on the computer? Will the instructions be on the system, provided by the teacher, or provided on paper? The material could be designed to be dependent on the teacher for some explanation or introduction. Too often, the microcomputer is thought of as a device to replace the teacher instead of a tool for the teacher to use in the classroom. Therefore, the designer should consider integrating the two components to strengthen the presentation of the material. Before the computer module is even designed on paper, these components must be considered. A good computer module is one that achieves the objectives it is designed to accomplish and which captures the student's interest.

7. Design Lesson

Once the strategy, sheets, and objectives have been selected, the instructional sequence must be defined. The strategy selected—drill and practice vs. simulation vs. tutorial—will somewhat determine the sequence.

8. Test and Assess

In assessing the product, all the above elements should be kept in mind. In assessing students' performance, it is important to remember that students should know where they stand in relationship to the required learning. This does not necessarily mean that they need a specific "correct" sign or a grade. However, a feeling of mastery of accomplishment is vital to all learning.

B. Motivation

Motivation is probably the most important ingredient in the teaching-learning process. Teachers should be especially concerned with what makes computer material motivating. The purpose of this program is to get the participants to be as creative as possible in developing ideas. Before students can be motivated, the teacher must also have a clear motive.

Research in the field of motivation dealing with computer material was done by Dr. Tom Malone at Xerox Palo Alto Research Center and reported in his "What Makes Things Fun to Learn: A Study of Intrinsically Motivating Computer Games." Dr. Malone divided this into three catagories: challenge, fantasy, and curiosity.

Challenge

Even rich, responsive environments may be unappealing unless they provide an appropriate goal.

1. Obvious Goal. Simple games should provide obvious goals. Usually the more obvious and compelling the goal is, the better.
2. Appropriate Difficulty. A complex environment with built-in goals should be structured so that users can easily generate goals of appropriate difficulty.
3. Fantasy Goals vs. Goals of Skills. The best goals are often fantasy goals (like reaching the moon in a rocket) rather than simply goals of using a skill (like doing arithmetic problems).
4. Performance Feedback Necessary. The players must be able to tell whether they are getting close to the goal.

Uncertain Outcome: A computer game is not challenging if the player is either certain to win or certain to lose. There are four ways to make the outcomes uncertain for players over a wide range of ability levels:

1. Variable Difficulty Level. Games should be playable at different difficulty levels:
a. Determined automatically by the program according to how well the player does (drill and practice)
b. Chosen by the player (perhaps with ego-involving labels like "Cadet," "Captain," "Commander")
c. Determined by the opponents' skill (chess)

2. Multiple Level Goals. Having different levels of goals, players whose outcome is certain at one level of goal may still be challenged by another level of goal. Two features create multiple level goals:
a. Score-keeping. The score can reflect the number of tries, the number of successes, the resources expended and so on.
b. Speeded responses. The computer times the responses, thereby making the game more of a challenge.

3. Hidden Information. Many games, especially guessing games, make the outcomes uncertain by hiding information from the player or players and selectively revealing it. This feature seems to provoke curiosity as well as contributing to the challenge of the game.

4. Randomness. A final way of making the outcomes of a game uncertain is to introduce randomness. Many gambling games seem to succeed almost entirely on the basis of this principle, and randomness can be used to heighten interest in many other kinds of games (adventure games).

Fantasy

Fantasies often make computer games more interesting. In general, games that include fantasy show or evoke images of physical objects or social situations. These objects or situations may involve varying degrees of social or physical impossibility, from completely possible (running a lemonade stand in "Lemonade") to completely impossible (moving instantly from one barrier to another in "Chase"). Nonfantasy games involve only abstract symbols.

Curiosity

Curiosity can be built in a student's mind through the use of graphics, audio effects, or feedbacks. Students can be encouraged to try different options.

Informative Feedback. One way of making environments interestingly complex is to make them responsive:

1. Feedback should be surprising. One way to do this is by using randomness.
2. To be educational, feedback should be constructive. The feedback provided should reinforce and correct the students' thinking, not just say, "WRONG."

Audio and Visual Effects.

1. As decoration or to enhance the fantasy. When sound and graphics are used in a program regardless of what the player does, they can be considered merely "decorative." This kind of effect may enhance the initial interest of a game, but might quickly become boring.
2. As reward. When sound or graphics displays are used to reward good performance, they can increase the salience of the goal and thus add to the challenge of the game. The challenge of reaching a goal, however, can sometimes distract people from exercising their curiosity, and so might decrease certain kinds of learning.
3. As a representation system. Perhaps the best use of sound and graphics in computer games is to represent and convey information more effectively than with words or numbers. For instance, the "Darts" game uses a graphic representation system for fractions, and the "Breakout" game signals bounces and misses of the ball with different tones.

One use of the above list of features is simply to suggest additions to existing or planned computer games. Almost no computer games include all the features mentioned above, and it is usually possible to think of ways that any given game could incorporate more of these features. A learning program, of course, could combine the qualities and appeal of commercial games with valid learning results.

C. Interaction

One of the major teaching assets of the computer is its availability for interaction between the student and the medium. This is achieved by questioning, input, and feedback. As early as 1917, it was demonstrated that a student who made active responses during study time increased his/her learning. In computer courseware, it is suggested that there should never be more than three screens of text without an interaction. Among the techniques available to the computer are typed responses; multiple choice selection, including "cursor control" (moving an arrow until it rests on the right answer); return to a previous panel; providing information on request; and many of the other techniques available to a live teacher. The student can control the speed of performance and the teacher can intervene to encourage discussion of concepts presented.

1. Question and Prompting Techniques

This is one of the most important aspects of interaction. If the question is stated in a confusing manner, the chance of the user making a technical error is heightened. Students should not have to guess what the program wants them to do.

2. Input and Error Processing

Input can be a key to the success of the program. If the input and prompting are well designed, error messages should concentrate on the subject area and not the mechanics of input. (Since the computer is limited compared to the teacher, the designer should try to anticipate the type of input and offer various options for receiving it. The program can give more information, refresh memory, or lead a student through a tutorial about the concept as a whole.)

3. Feedback

Appropriate feedback is another essential for successful courseware. Feedback reinforces students' thinking or redirects them to the right answer. It should motivate and challenge the student.

Some general suggestions: As a rule, a response that helps students determine why they are wrong is better than sarcasm or cuteness. Make the reinforcement positive and motivational. Avoid reinforcement that is time-consuming and slows the pace of the program. The feedback for an incorrect response should be content oriented (rewording the question is sometimes appropriate; if not, further hints can be given). If the students are in a drill-and-practice mode, a review of the missed questions at the end of the drill can reinforce learning.

D. Layout and Graphics

The microcomputer requires the designer to adapt text to a television screen. Aesthetic layout of material contributes to appealing, motivating, and educational effects.

Designers should think of themselves as artists creating the most visual and persuasive message possible. The text, above all, should be legible, easy to read, high-lighted, attractively displayed, and well organized.

The medium here is the screen—a frame somewhat analogous to that of a filmstrip or movie. The advantage of the computer over the filmstrip is that animation and the presentation of ideas in segments are possible. In addition, students can interact with the computer.

Designers should know the screen size and capabilities of the microcomputer they are working with. For instance, how many characters of text can be presented in one line, up or down the screen? What kind of detail is available in graphics? How difficult is it to present a certain image on the screen? Could it be done more effectively another way?

A courseware designer should be both an author and an artist. Many of the elements of good computer courseware depend on principles familiar to artists and printers.The appropriate use of space and contrast, the way the human eye travels from left to right and up and down, and so on. In traditional terms, the designer of courseware should recognize:

1. The size of the screen and its most effective visual qualities; the appropriate use of white and black, contrast, and the framing qualities of space. A crowded screen, like unrelieved columns of type, is unappealing.

2. Legibility. Consider spacing and type size, as well as awareness of the age group addressed. Although upper and lower case are generally recognized as most readable, for lower grades short sentences in caps may be more appropriate.

3. Centering. Centering of the title and subheads and indentation of paragraphs make for easier reading. The centering of important facts (combined with boldface, italics, and other attention-getting typography) provides emphasis.

4. Placement. The human eye tends to focus just above the center of the screen. It is bad layout to begin a presentation below the middle. Research shows that students seldom read text below a question. Important information should always be put above the question.

5. Sentence and word breaks. Careful hyphenation of words is important in typed copy and even more important in a computer, which has a tendency to "scroll" or break-up words mechanically (ending one line with a "t" and beginning the next with "hat").

6. Sequence breaks. Placing the text on the screen in small manageable chunks helps the student to absorb meaning.

7. Appropriate reading level. Periodically check the reading level of the material in various approved ways.

8. Emphasis. In addition to spacing, centering, the use of contrast, caps, boldface and italics, other typographic techniques available on the computer include underlining, boxing, framing, and reverse printing (white on black). Remember, however, that over-indulgence in attention-getters defeats their purpose.

9. Variety. For learning purposes variety is essential. One rule of thumb for courseware is that each text screen should be visually different from its predecessor. The eye should be able to detect new information from the layout.

Audio-visual techniques
Beyond the techniques available to print for emphasis and attractiveness, the computer can make use of the assets of the audio-visual media. These include sound, change of speed in presentation of the text, movement and animation, cyclical imagery, and such attention-getters as flashing lights and arrows.

E. Testing and Evaluating
Before testing one's own courseware, it might be well to evaluate some of the commercial products available in order to get a handle on what will be successful or unsuccessful in one's own program. Three well-known products are "Oregon," "Trapezoids," and "Math Invaders."

"Oregon" is a simulation that includes competition, graphics, timed responses, challenge, and a well-designed model. "Trapezoids" is a tutorial which uses graphics and interaction to teach the concept. "Math Invaders" is a game which rewards the students for answering quickly. Its weakness is that there is no penalty for getting the wrong answer. (Students tend to answer fast rather than correctly.) The scoring is based on the game instead of its educational concepts, and it encourages players to win rather than absorb math facts. Before critiquing your own product, it might be worthwhile to redesign "Math Invaders" in order to make it both motivationally and educationally sound.

In testing any computer courseware, three types of evaluation should take place:
1. A technical review of the program
2. Evaluation of its educational concepts
3. Use in classroon setting

Teachers should follow the same steps in evaluating their programs. (If the teacher is designing programs to be marketed, more formal testing procedures are recommended.)

Technical Review
Should evaluate the following: Text layout is attractive; all material is grammatically correct; user can regulate material (press returns).

Test by typing all combinations of anticipated input to see how they will be handled; type unanticipated input; type a ridiculous answer to see if it will be accepted; if more than one question appears on the same screen, answer each one with unanticipated answers.

Educational Review
Check that instructions are logical and clear; text is readable; text is at correct reading level; use of graphics and sound is appropriate; material is presented in a logical order and in correct segment sizes; feedback is appropriate to the lesson; difficulty level is appropriate to the audience; the program as a whole is pedagogically sound.

Classroom Review
Evaluate the following: Package is motivational; has high degree of student interest; program achieves its purpose; information displays are effective; students are able to read the directions and follow the sequence of material; students can operate the program independently (if so designed); program can be easily implemented by the teacher.

Software Development Checklist

A. Software Needs Assessment

1. Have you targeted the group for which the software is to be developed and their unique instructional needs?	Yes	No
2. Have you determined the appropriateness of the microcomputer application?	Yes	No
3. Have you identified the necessary personnel for the development and evaluation teams?	Yes	No
4. Have you set the goals and objectives to be met by the software?	Yes	No
5. Have you determined the sequence of learning to be achieved by stating the order of skills to be achieved?	Yes	No
6. Have you decided which of these skills will be presented on the computer and which will be accomplished by other means?	Yes	No
7. Have you determined the strategy to be used in the presentation so that the requisite objectives will be achieved and so that it will fit into your curriculum?	Yes	No

B. Software Development

1. Have you selected a learning theory model to guide development?	Yes	No
2. Have you reached agreement on learner outcomes?	Yes	No
3. Have you decided on the learning strategies to be used?	Yes	No
4. Have you reviewed the role of support materials, and in what media and by whom they will be presented?	Yes	No
5. Have you defined the instructional sequence? (Remember that the modes selected—drill and practice vs. simulation vs. tutorial—will to some extent determine the sequence.)	Yes	No
6. Have you provided the students with appropriate and varying degrees of difficulty?	Yes	No
7. Have you set design parameters?	Yes	No
8. Have you designed a lesson format?	Yes	No
9. Have you decided on the most appropriate layout and graphics?	Yes	No

10. Have you provided for appropriate interaction?	Yes	No
a. Clear questioning and prompting techniques?	Yes	No
b. Well-designed input and error processing?	Yes	No
c. Feedback which reinforces student learning or redirects them to the correct answer?	Yes	No
11. Have you reviewed the assembly of programs and support materials in a usable package?	Yes	No

C. Software Evaluation

1. Have you developed an ongoing evaluation plan?	Yes	No
2. Have you tested your software with students/teachers prior to implementation?	Yes	No
3. Have you allowed for a technical review to determine that:		
a. Text layout is attractive?	Yes	No
b. All material is grammatically correct?	Yes	No
c. User can regulate material (press returns)?	Yes	No
4. Have you allowed for an educational review to determine that:		
a. Instructions are logical and clear?	Yes	No
b. Test is at correct reading level?	Yes	No
c. Use of graphics and sound is appropriate?	Yes	No
d. Material is presented in a logical order?	Yes	No
e. Material is presented in correct segment sizes?	Yes	No
f. Feedback is appropriate to the lesson?	Yes	No
g. Difficulty level is appropriate to the audience?	Yes	No
h. The program as a whole is pedagogically sound?	Yes	No
5. Have you allowed for a classroom review to determine that:		
a. Package is motivational?	Yes	No
b. Package has high degree of student interest?	Yes	No
c. Program achieves its purpose?	Yes	No
d. Information displays are effective?	Yes	No
e. Students are able to read the directions and follow the sequence of material?	Yes	No
f. Students can operate the program independently (if so designed)?	Yes	No
g. Program can easily be implemented by the teacher?	Yes	No
6. Have you developed a plan for periodic review and revision?	Yes	No

Section V: Implementation and Training

"They don't want to stop for lunch."

Rationale

Planning for the use of a computer to help teach the curriculum is incomplete without some allowance for a phased implementation of the plan and some carefully considered time lines for teacher training. The resistance to change in education has been thoroughly documented in the research. This fact is especially important to consider in the use of technology, for technophobia (fear of technology) is a very real problem. Because we tend to teach as we have been taught, few teachers among the current generation can fully use technology without some additional assistance.

Implementation of technology must be a gradual process. Training a selected group of people first, rather than wholesale building-by-building or subject-area-by subject-area implementation, has many advantages. If these people can be made to feel completely comfortable with the computer, or other technology, they will serve as role models for other teachers. Further, if these key people are part of the planning process, they will feel a greater sense of ownership. What little research has been done in this area, all points to participation as a key ingredient in successful implementation and integration of computers into the curriculum.[1] Upon this initially trained group rests much of the responsibility for eventual implementation by the rest of the faculty.

Limited budgets for the acquisition of hardware and software also speak to the need for gradual implementation. Implementation should begin only in those areas where resources permit. The degree of implementation is determined by the number of computers available and the level of trained staff. Also, because technology will be constantly changing while this implementation process is on-going, the plan must be flexible enough to adapt to necessary changes. Here the key is determining whether the newer technology provides anything which is necessary for successful implementation without seriously undermining the already completed steps in the process. Newer is not always better.

The most important step in the process of implementation is the selection of one key person to whom will be assigned the tasks of training and facilities management. Schools currently using the technology all attest to increased usage if there is a local district resource person. What follows are suggestions as to the role such a person might play in the district, and specific tasks to be considered in training and facilities management.

[1] Ragosta, M. Barriers and Incentives to Computer Use, Project Report for Educational Testing Service.

Teacher Training

Outlined below is a suggested model for training teachers who will be involved with using the computer in the curriculum. The level of training needed depends on the amount of time spent teaching about the computer itself. As the model suggests, training is not considered to be a one-time in-service activity. It must be continuous. As technology continues to evolve so must the knowledge base of the teachers.

Ideally, a computer should be available at any time for a teacher to use. Integration will not be easily accomplished if all training is outside of the normally contracted day. Some combination of in-service activities, release time, and availability of equipment for checkout over weekends or vacations is preferred.

LEVEL 1	**FAMILIARITY WITH EQUIPMENT**		
Recommended for *all* teachers	Instruction to the microcomputer 1.5 hr.		
LEVEL 2	**FAMILIARITY WITH APPLICATIONS**		
Recommended for *all* teachers	Integrating Computing Into Curriculum and Lesson Planing 2.5 hrs	Instructional Software Evaluation 1 hr.	Instructing a Computer 1hr.
LEVEL 3	**DEVELOPING SOFTWARE**		
Recommended for teachers who will teach about computers or develop their own courseware	Authoring Utilities	Courseware Design	Computer Programming

Hardware Management and Implementation Strategies

The best-laid plans for using computers have gone awry because someone forgot to count up the number of electrical outlets required for the type of computer to be used. Many planners fail to recognize that different types of computer usage are dependent on varying numbers of computers. The following section attempts to provide some guidelines for suggested ratios and configurations. While these strategies are ideal, not absolutely necessary, they are based on experiences of current users. Many schools can be successful under less than ideal conditions but unrealistic expectations for the environment, or the number of computers, can surely lead to less than ideal usage.

The ratio of computers to individuals is dependent on the type of task assigned. This ideal ratio to aim for is outlined below by application.

	Computers per	**Students**
Programming	1	2
Drill and Practice	1	1
Tutorial	1	1
Simulation	1	Small Group
Problem Solving	1	Small Group
Information Retrieval	1	Dependent on Application

The physical location of the computer can present difficulties if the environment is not considered. Unlike mainframe computers, microcomputers present few demands, but it is necessary to provide adequate electricity for each machine. Tables for the equipment should accommodate students of various sizes since most computer programs require some use of the keyboard. Carpeting can present a problem if it generates a lot of static electricity during the winter. All of these potential problems can be overcome easily if some thought is given to such needs before the hardware is ordered.

Another important consideration is the most appropriate method for maintaining the equipment. Several options usually exist, ranging from a district technician handling all repairs to contracts with a local firm to provide on-site maintenance within a guaranteed time frame. Someone familiar with the hardware must explore all local options and their feasibility in light of cost, staff availability, and degree of support needed. The number of machines to be maintained usually provides a critical threshold.

Computers are placed in schools today in a variety of configurations. Each strategy has its advantages and disadvantages. The following outline does not suggest that these are mutually exclusive strategies. Any combination may be successful depending on the proposed use in the curriculum.

Computer Lab

Five or more computers located in a resource center. Often includes two or more printers.

This setting lends itself to networking, teaching programming, and individualized instruction in a variety of subject areas simultaneously.

The disadvantages of this strategy include problems with moving students to the lab, scheduling and supervision, and the integration of classroom activity with lab activity.

Media Center
1. Equipment available on a checkout basis like other AV equipment. This lends itself to making the computer maximally available when appropriate as a tool. The disadvantages to this strategy include scheduling and management, allowing too much selectivity in implementation, and increased maintenance.
2. Equipment available in the media center as indicated for the computer lab above. The same advantages and disadvantages apply.

Classroom
Computer(s) located in individual instructional setting.

This arrangement lends itself to enhanced implementation in all areas of the curriculum because the computer is constantly available as a learning station. The disadvantages to this strategy include inefficient scheduling and usage, insufficient number of machines for small group or class activities, distractions to other students, and increased maintenance.

Other Implementation Concerns
Because technology is dynamic, the person assigned primary responsibility for implementation and facilities management must remain open to change. The learning process and the planning process will be continual. Of special concern is the role this person plays in acting as a liaison among between administrators, instructional staff, and the community. Public relations activities should involve the school board and the community whenever possible. Changing technology, many feel, will increase the interdependence of community, school, and industry. Finding ways to work together today will lead to more successful implementation in the future. The key person must be viewed by others as someone familiar with hardware though not a technician, as well as someone familiar with the ever more available software resources. As facilitator, this person plays a key role in encouraging ever increasing means of integrating technology into the curriculum.

Implementation and Training Checklist

Facilities Management

1. Has the environment for the computer(s) been considered?
   Electrical outlets
   Portable carts
   Tables
2. Which configuration, or combination of configurations, best suits the curriculum goals?
3. What procedures and costs are associated with obtaining, storing, and distributing supplies such as diskettes and paper?
4. How will courseware and documentation be mad available to students and staff?
5. What maintenance support for the hardware is supplied by the vendor and what maintenance procedures can be handled by personnel at the school site? What costs are involved with maintenance?

Training

1. How many staff members have used a microcomputer?
2. What additional staff training is necessary to achieve curriculum goals?
3. How will this training be delivered? Who will deliver it?

Implementation

1. In which area(s) do adequate resources exist to begin the implementation process?
2. What are the implementation time lines?
3. How will additional resources (more trained staff or more computers) be supplied as needed in implementation?

Section VI: Bibliography and Research

Computer Technology in the Classroom*

Periodicals
The periodicals noted below are both education and computer related; however, some have education as the major emphasis while others emphasize computers. They are identified as "Educ." and "Comp." depending on their focus.

AEDS Journal, AEDSD Monitor, and AEDS Bulletin
Available from the Association for Educational Data Systems,
1201 Sixteenth Street N.W.
Washington, DC 20036.
Educ.

Book of Apple Computer Software, The
Four hundred pages of annotated reviews of Apple software.
Sections include business, education, utilities, games.
All programs rated on 6 criteria; for example, documentation, ease of use, and so on.
Comp.
Lawndale, CA: The Book Co. Annual.

Computer Classroom
Emphasis is on using sound educational techniques in the classroom.
One year $16.00.
Published by Intentional Educations, Inc.
51 Spring Street
Watertown, MA 02172
Educ.

COMPUTE
A monthly publication with articles on programming and applications for Atari, PET, and Apple users.
$20.00.
P.O. Box 5406
Greensboro, NC 27403
Comp.

COMPUTERWORLD
A weekly newspaper published by Computerworld, Inc.
797 Washington Street
Newton, MA 02160
Comp.

Computing Teacher, The
Designed for educators interested in the instructional uses of computers and calculators.
Nine issues.
Published by the Oregon Council for Computer Education, Computing Center, Eastern Oregon State College,
La Grande, OR 97850
Educ.

Creative Computing
Applications and software magazine for home, business, and education.
Evaluations of hardware and software and programming ideas for beginners to advanced.
Twelve issues, $20.00.
P.O. Box 789-M,
Morristown, NJ 07960
Comp.

Datamation
A free monthly periodical.
1801 South LaCienega Blvd.
Los Angeles, CA 90035
Comp.

Electronic Learning
A well written and entertaining magazine that provides information about developments in electronic learning, especially computers.
Eight issues $19.00.
Published by Scholastic Magazine
902 Sylvan Avenue
Englewood Cliffs, NJ 07632
Educ.

Educational Computer
A bi-monthly publication for teachers on using computers, especially microcomputers, in the classroom.
$12.00.
P.O. Box 535
Cupertino, CA 95015
Educ.

Educational Technology
Published by Educational Technology Publications
140 Sylvan Avenue
Englewood Cliffs, NJ 07632
Educ.

Interface Age
A monthly publication on computing for home, classroom, and business applications.
P.O. Box 1234
Dept. CP
Cerritos, CA 90701
Comp.

Journal of Computer-Based Instruction
Published quarterly by the Association for the Development of Computer-based Instructional Systems (ADCIS), this scholarly journal contains articles on theory, research, and utilization of CAI and CMI.
$12.00 for nonmembers.
ADCIS, Computer Center, Western Washington University,
Bellingham, WA 98225
Educ.

MAEDS Journal
Published periodically.
Minnesota Association for Educational Data Systems.
1925 W. County Road B2
St. Paul, MN 55113
Educ.

The Mathematics Teacher and The Arithmetic Teacher
National Council of Teachers of Mathematics.
Published eight times a year at:
1906 Association Drive
Reston, VA 22091
Educ.

Microcomputer Index
Microcomputer Information Services,
2646 El Camino Real #47
Santa Clara, CA 95051
4/year; $22.00.
Also available online through DIALOG Information Services
3460 Hillview Avenue
Palo Alto, CA 94304
as File 233.
Comp.

Microcomputers in Education
QUEUE
5 Chapel Hill Drive
Fairfield, CT 06432
12/year, $15.00.
(Newsletter)

Nibble
Hardware and software tips and techniques, and programs for the intermediate to advanced Apple user.
Eight issues, $17.50.
P.O. Box 325
Lincoln, MA 01773
Comp.

On Computing
Articles on developments in the field of personal computing—use, books, applications, selection.
Published quarterly by McGraw-Hill.
$24.00.
70 Main Street
Peterborough, NH 03458
Comp.

Peelings II
A bi-monthly publication which reviews Apple software—games, utilities, languages, simulations/educational, technical, and others.
Six issues.
$15.00.
945 Brook Circle
Las Cruces, NM 88001
Comp.

Personal Computing
Articles and programs on education, home, and business applications for TRS-80, PET, and Apple users.
Monthly, $14.00.
1050 Commonwealth Avenue
Boston, MA 02215
Comp.

Pursor's Magazine
Articles and reviews of games, utilities, and educational and business software.
For Apple, Atari, and TRS-80 users.
Free copies available to instructors teaching courses for teachers.
Four issues, $12.00.
P.O. Box 466
El Dorado, CA 95623
Special editions available to Apple, Atari, and TRS-80.
$3.00 each.
Comp.

Recreational Computing
Articles and programs for the user of small home computers.
Bi-monthly, $12.00.
Published by People's Computer Company
1263 El Camino Real
Box E
Menlo Park, CA 94025
Comp.

Softalk
A monthly magazine for Apple users—beginning to advanced; covering hardware, software, and applications for home, business, and education.
Free to Apple owners.
Send your serial number to:
Softalk
11021 Magnolia Blvd.
North Hollywood, CA 91601.
Comp.

The Journal—Technological Horizons in Education
Published by Information Synergy,
Reader Service Department
P.O. Box 992
Action, MA 01720
Educ.

* Much of this bibliography was reprinted with permission from a document entitled "Computer Resources" developed by Total Information Education Systems (TIES), Minnesota School District,
Data Processing Joint Board
1925 West County Road
B2
St. Paul, MN 55113

Newsletters
Apple Educators Newsletter
AEN
9525 Lucerne
Ventura, CA 93003

Call A.P.P.L.E.
A club newsletter in magazine format, including hardware and software tips and techniques, programs, and articles.
Nine issues.
Club membership: one-time fee, $25.00; annual dues, $15.00.
304 Main Avenue South
Suite 300
Renton, WA 98055

Contact 6
Published by Apple Computer, Inc.
10260 Bandley Dr.,
Cupertino, CA 95014

Timely TIES Topics
On Instructional Services, Total Information Educational Systems,
Minnesota School District, Data Processing Joint Board,
1025 West County Road B2
St. Paul, MN 55133

Users—The MECC Instructional Computing Newsletter
Published by MECC User Services
2520 Broadway Drive
St. Paul, MN 55133

Books and Articles

Beck, John J. Computer Literacy for Elementary and Secondary Teachers.
Paper presented at Annual Meeting of Texas Assn. for Supervision and Curriculum Development (ED 208 8).

Chambers, J.A. and Bork, A. Computer Assisted Learning in U.S. Secondary/Elementary Schools.
(Research Report No. 80-03.)
Fresno, CA: Center for Information Processing,
California State University, 1980.

Charp, S. "Effectiveness of Computers in Instruction." Raleigh, N.C.
Conference Procedings: The use of computers in secondary schools, April 1980. pp.1-11.

Gagne, Robert M., and Leslie J. Briggs. Principles of Instructional Design (Second Edition).
New York: Holt, Rinehart and Winston, 1974.

Gall, Meredith Damien. Handbook for Evaluating and Selecting Curriculum Materials.
Boston: Allyn & Bacon, 1981.

Hakansson, J., and Roach, L. "A Dozen Apples for the Classroom," Creative Computing, 1979, 5: 52-54.

Hall, E.E. Issues Related to the Implementation of Computers in Classroom: Where to Now? Austin, Texas: The University of Texas, 1981.

Hirshbey, P., and B.L. Trippett. "3 Successful Programs in Computer Literacy."
Instructional Innovator, 126:26–31, September, 1981.

Hunter, B. "Computer Literacy in grades K–8, "Educational Technology System, 10, No. 1: 596, 1981–2.

Designing Instructional Computing Materials.
St. Paul, Minnesota: Minnesota Educational Computing Consortium, 1981.

"Microcomputers," (symposium) Mathematics Teacher, 74:588–9+, November, 1981.

Pratt, David. Curriculum Design and Development. New York: Harcourt Brace Jovanovich, 1981.

Scheingold, K. Issues related to the Implementation of Computer Technologies in Schools: A Cross-sectional Study. Children's Electronic Laboratory Memo No. 1. (A report prepared under contract No. 400-80-0023.) Preliminary report presented to the National Institute of Education Conference on Issues Related to the Implemenation of Computer Technology in Schools, Washington, D.C., February, 1981.

Stevens, D.J. "Computers, Curriculum, and Careful Planning, " Educational Technology, 21:21–4, November, 1981.

Watt, D.H. "Computer Literacy: What Should Schools Do About It? "Instructor, 91:85-7, October, 1981.

Wiles, Jon, and Joseph Bondi. Curriculum Development: A Guide to Practice. Columbus, Ohio: Charles E. Merrill, 1979.

Wilson, K.G. "English Teachers: Keys to Computer Literacy. "English Journal, 70:50–3, September, 1981.

Wright, Annett. Developing Standards and Norms for Computer Literacy. Discussion paper 06/80. (ED 208 847).

Microcomputing Software Evaluation Organizations

Educational Products Information Exchange (EPIE)
Box 620
Stony Brook, NY 11790
Kenneth Komoski, Executive Director

Purpose: EPIE is a nonprofit consumer-supported agency that gathers and disseminates descriptive and analytical information, along with empirical information on performance and effects on learners, about instructional materials, equipment, and systems.

Publications: Microcomputer Courseware/Microprocessor Games. EPIE Materials Report 98/99m, 1981, 54 pp., $25.00.

MicroSIFT, Northwest Regional Educational Laboratory, Computer Technology Program, 300 S.W. Sixth Avenue, Portland, OR 94204; Judith Edwards-Allen Director.

Purpose: MicroSIFT is a National Institute of Education-sponsored clearinghouse for microcomputer instructional software, K–12. It was established to design effective procedures for collection, evaluation, and dissemination of materials and information, and to incorporate a flexible user support and technical assistance component.

Publications: Evaluator's Guide for Microcomputer-based Instructional Packages, 1981, 61 pp. (ERIC Document Reproduction Service, P.O. Box 190, Arlington, VA 22210, ED 206 330, MF-$.91/PC–$5.30)

MicroSIFT News, Volume 1, Number 1, October 1980; Volume 2, Number 1, October 1981.

Foundation for the Advancement of Computer-aided Education, Educational Program Evaluation Centre (EPEC), 20863 Stevens Creek Blvd., Bldg. B-2, Suite A-1, Cupertino, CA 94015; G. Gregory Smith,Executive Director.

Purpose: The Foundation seeks to foster excellence in computer-assisted education and to recognize programs that demonstrate excellence, innovation, and effectiveness in learning environments. EPEC reviews commercially available educational courseware for all major microcomputer systems, regarding uses, content, and educational validity. Reviews are written by recognized computing education authorities with direct experience in the content areas of programs.

Publications: Journal of Courseware Review, P.O. Box 28426, San Jose, CA; $6.95/issue.

Professional Organizations and Sources of Assistance

Professional Organizations—for membership information, inquire at the addresses listed.

National:
Association for Computing Machinery (ACM)
1133 Avenue of the Americas
New York, NY 11036

Membership Fee: $35
Student: $11

ACM Special Interest Group on Computer Uses in Education (SIGCUE)
Association for Computer Machinery
P.O. Box 12105
New York, NY 10249

Membership Fee:
$4 (ACM Member)
$11.50 (Non-ACM Member)
Student:
$2 (ACM Member)

Association for the Development of Computer Based Instructional Systems (ADCIS)
Mrs. Joan Hayes
Computer Center
334 Bond Hall
Western Washington State College
Bellingham, WA 98225

Membership Fee: $20

Affiliated Group:
National Consortium for Computer-Based Musical Instruction (NCCBMI)

Association for Educational Communications and Technology (AECT)
1126 Sixteenth Street, N.W.
Washington, DC 20036

Association for Educational Data Systems (AEDS)
1201 Sixteenth Street, N.W.
Washington, DC 22335

Membership Fee: $25
Student: $10

Hewlett Packard Upper Midwest User's Group
c/o Computer Center
University of Wisconsin
LaCrosse, WI 54601

National Council of Teachers of Mathematics (NCTM)
1906 Association Drive
Reston, VA 22091

Membership Fee: $12
Student: $6

State:
Minnesota Association for Education Data Systems (MAEDS)
1925 W. County Road B2
Roseville, MN 55133

Membership Fee: $10
Student: $3

Minnesota Computer Society (MCS)
P.O. Box 35541
Minneapolis, MN 55435

Membership Fee: $7
Student: $3

Minnesota Council of Teachers of Mathematics (MCTM)
2520 Broadway Drive
Lauderdale, MN 55113

Membership Fee: $5
Student: $1

MECC Users Association (MAU)
2520 Broadway Drive
Lauderdale, MN 55133

Membership Fee: $2

Mini'App'Les (Apple User Group)
13516 Grand Avenue S.
Burnsville, MN 55337

Membership Fee: $10

Minnesota Educational Media Organization (MEMO)
5408 Knox Avenue South
Minneapolis, MN 55419

Minnesota Council on Quality Education and Title IV Computer-Oriented Programs

CQE Projects

"Computer Video"—Osseo Public Schools.
Investigation of curriculum combining video disks and microcomputers for instruction.
Contact: Brian Doyle, Project Director
Osseo Public Schools
317 Second Avenue Northwest
Osseo, MN 55369
(612) 425-4131 extension 414

"Direct Curriculum Support for the Regular Classroom Teacher with Mainstreamed Special Education Students"—Jefferson High School, Bloomington, 9-12. Support Materials for the moderately handicapped.
Contact: Gretchen Durkot, Project Director
Jefferson Senior High
4001 West 102nd Street
Bloomington, MN 55437
(612) 831-4641

"Problem Solving Through Strategy Games"—Olivia Public Schools. Microcomputer use of strategy games to improve problem-solving and thinking skills, including math concepts, for gifted and talented students.
Contact: Fred Nolan, Elementary Principal
Olivia Elementary School
709 South Ninth Street
Olivia, MN 55277
(612) 523-1962

"Recreational Education Alternative Curriculum Techniques (REACT)"—Columbia Heights Public Schools. SELO-based computer programs for physical education.
Contact: Jo Boettcher, Project Director
Marshall University High School
1313 West Fifth Street
Minneapolis, MN 55414
(612) 379-0428

"School Micros"—Ortonville Public Schools. A variety of applications including reading levels, improving writing, and management.
Contact: Curt Johnson, Project Coordinator
Ortonville Public Schools
Box 247
Ortonville, MN 56278
(612) 839-6181

"Academic Equity for Rural Schools"—Littlefork-Big Falls Public Schools. Self-instructional computerized education.
Contact: Roger Nuensinger, Superintendent
A.E.R.S. Project
Independent School District #362
Littlefork, MN 56653

"Changing Health Behavior"—St. Paul Public Schools. Computerized health assessment, records and curriculum.
Contact: Paula Peterson
Department of Public Health
560 Cedar
St. Paul, MN 55101
(612) 292-7741

Title IV Projects
"Automated Special Services Information and Student Tracking ASSIST"—Hopkins Public Schools
Contact: Loren L. Benson
Hopkins Public Schools
1001 State Highway 7
Hopkins, MN 55343
(612) 933-9201

"Computer-Assisted Intelligibly for Retarded Students"—Minneapolis Public Schools. To develop a remedial strategy for teaching individualized word lists to retarded unintelligible students.
Contact: Deanne Magnusson
Special Education Service Center
254 Upton Avenue South
Minneapolis, MN 55405

3. "Computer-Assisted Problem Solving Skill Practice for Elementary Students"—Rochester Public Schools. Exploration of how to develop a problem-solving skills matrix, a game analysis system, and a micro-library of problem-solving software. K–6.
Contact: Donna Stanger
Lincoln Elementary School
903 Center Street
Rochester, MN 55901
(507) 289-3756

"Computer-Assisted Typesetting"—Roseville Public Schools, 10-12. Use of the latest typesetting technology to improve communication skills for all students and, especially, skills for vocational students in printing.
Contact: Rod Tooley
Kellogg Senior High School
15 East County Road B
Little Canada, MN 55066
(612) 488-4201

"Computer-Based Educational Laboratory"—Red Wing Public Schools, K–12. Use of computers for tutorial assistance, drill and practice, skill mastery and enrichment (includes math, language, communications, foreign language, science, social studies, computer literacy).
Contact: Craig R. Olson
525 East Avenue
Red Wing, MN 55066
(612) 388-7181

"Computerized Language Analysis"—Duluth Public Schools, P-12. Use of computers to speed up and improve standardized language tests, analyze samples, and store data to measure student's future program.
Contact: Cheryl Abramson
Central Administration Building
Department of Special Services
Lake Avenue and Second Street
Duluth, MN 55802

"Computer Modifications for the Handicapped"—West Central ECSU, P-12. Modification of existing programs for exceptional children.
Contact: Laurie S. Satre
West Central ECSU
120 South Vine Street
Fergus Falls, MN 56537
(218) 739-3273

"Interdependent Support Service Model - TMR"—Hennepin Technical Center, K–12. Assessment of development of TMR students in communications and motor skills.
Contact: Lois O. Haug
Katherine Curren School
1600 West Excelsior Avenue
Hopkins, MN 55343
(612) 935-7158, extension 232

"Issues in Nutrition"—St Paul Public Schools, 7–12. Use of microcomputer disks for nutrition instruction.
Contact: Kathleen H. Stuart
360 Colborne
St. Paul, MN 55102
(612) 298-5404

"Microcomputer and Media Services"—Cannon Falls Community Schools. Computerization of media service centers.
Contact: Jim Deacon
Cannon Falls Community School
820 East Minnesota Street
Cannon Falls, MN 55009
(507) 263-3331

"Microcomputer Managed Audio Spelling Project"—Central Minnesota ESCU, 1-6. To develop new programs to improve spelling skills, geared specifically toward learning disabled.
Contact: Doris Bower*
Education Administration Building
St. Cloud State University
St. Cloud, MN 56301
(612) 252-9111
* Now at MECC

"Microcomputers in Education"—Robbinsdale Public Schools, K–6. Developing and testing programs to increase student achievement.
Contact: Bill Heck
Robbinsdale Area Schools
1148 Winnetka Avenue North
Minneapolis, MN 55427
(612) 533-2781, extension 291

"Micro-Math-Magic"—Mankato Public Schools, Grade 4. Use of computers to improve fourth grade math skills.
Contact: Gerald D. Hansen
1524 Hoover Drive
North Mankato, MN 56001
(507) 388-5202

"Secondary Basic Skills Development Design"—Duluth Public Schools, 7-8, 10-11. Computer drill in basic skills and record keeping.
Contact: Donna J. Mark
Central High School
800 Central Entrance
Duluth, MN 55811
(218) 722-6343

"Supplementary Computerized Reading and Mathematics"—Morgan Public Schools, K-12. Exploration of ways in which a small rural school can utilize computers, especially on basic skills; to develop software and teach computer literacy.
Contact: Richard R. Quast
Morgan Public Schools
P.O. Box 188
Morgan, MN 56266
(507) 249-3106

"TIME System (Total Information Management and Evaluation"—Hennepin Technical Center. A task analyzed curriculum-based assessment system for trainable mentally retarded.
Contact: TIME Project Director.
Katherine Curren School
1600 West Excelsior Boulevard
Hopkins, MN 55343
(612) 935-7178

County Level Plans

Sonoma County Office of Education
Computer Education Plan

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Philosophy

Computers have had and will continue to have a profound impact upon modern civilization and education. Planned used of the computer and its effect on society is of primary importance to the Sonoma County Office of Education. All students of sufficient ability will be expected to become computer literate and proficient in the ethical use of and application of computers in educational and vocational areas. The Sonoma County Office of Education staff must be prepared to include computers and related technology in all desciplines. SCOE staff will be presented opportunities to acquire skills in computer use and integration into the curriculum. Additionally, students and staff will use technology to develop logical and critical thinking skills. The SCOE Computer Education Plan will be updated, coordinated, and evaluated by a computer committee composed of school and community representatives.

Definition:
Computer literacy is a functional knowledge of computers and their effects on students and on the rest of our society. This knowledge should be at a level compatible with other knowledge based upon understanding how computers can help us learn, how computers can help us solve problems, what computer knowledge is essential to a modern understanding of other academic areas, what is included in the field of computer and information science, how computers are used as entertainment, and what role computers will play in our changing world. This approach to computer literacy easily changes as computers become more readily available and easier to use, as we learn more about computers and integrate this knowledge into our curriculum, and as the use of computers becomes commonplace in homes, businesses, government and in school.—David Moursund, International Council on Computers in Education

Computer Education Committee

Chairperson: Greg Malone, Computer Education Instructional Coordinator

SCOE Board of Trustees: Alan Huffman

Court Schools: Jack Thompson, Principal

ROP: Vic Trucco, Principal

Special Education: Mary Jo Hildebrand, Principal

Teacher: Dan Klassen, ROP

Student: Not Determined

Business & Industry: Not Determined

Computer Committee

Roles, Responsibilities, and Procedures

1. The committee will be composed of one representative from each school program operated by the county superintendent of schools, appointed yearly by the principal (program manager) of that school program.

2. Representatives from business and industry will be appointed by the committee to ensure that the needs of the local community are being addressed by the computer education plan.

3. There will be at least one parent and one student on the committee.

4. The committee shall coordinate computer education instructional coordinator for SCOE.

5. The Associate Superintendent for Educational Services shall oversee the operations of the committee.

6. The committee will develop, update, coordinate and evaluate the computer plan, subject to approval by the Board of Education and/or their representatives.

7. The committee will report to the Board of Education yearly the progress of the computer education program and recommend any changes to the plan.

8. The committee will conduct annual needs assessments for the staff training and equipment acquisition.

9. The committee will assist in establishing guidelines for equitable access to computers for students and staff.

Goals of Computer Education

1. A committee as noted, will be established to plan, update, coordinate, and evaluate the SCOE Computer Education Plan.

2. Students and staff of the Sonoma County Office of Education's school programs will have the opportunity to become computer literate at a level compatible with other knowledge.

3. Prior to high school graduation, students will have the opportunity to acquire an awareness of the implications of computers and information technology in society.

4. Staff will have an opportunity to be trained in the use of computers and integration of computers in the curriculum.

5. Students and staff will have an opportunity to use computer applications software in vocational and academic areas.

6. Students will have an opportunity to use computer-assisted instructional software.

7. Students and staff will have an opportunity to develop logical and critical thinking skills through the use of computers.

8. Students and staff will have an opportunity to acquire elementary skills in programming.

9. Students and staff will have the opportunity to develop an understanding and appreciation of the ethics associated with the use of a computer.

Current Status of Programs: Analysis of Needs

Court Schools
1983–84: A needs assessment for computer education was conducted on November 8, 1983 involving teaching staff, program manager, and computer education consultant. A brainstorming prioritizing process was used to determine needs. Specific priorities were:

1. Improved delivery of instruction to an atypical population

2. Teacher training in use of technology

3. Strategies and teaching techniques for hard-to-motivate delinquents

4. Implementation of behavioral/academic management systems

1984–85: Juvenile Hall and Deforest Hamilton and Mt. Hood schools received funding under AB–803 to utilize computer data-base activities to teach problem solving and decision making. After three days of staff development, teachers had their students using data bases for problem-solving, and reported average use of one hour every three school days in pairs. At a computer committee needs assessment meeting on May 7, 1985, it was a number one priority that more computers be acquired to allow sufficient student access and time on task.

Youth Camp did not apply for AB–803 Cycle I, but will apply for Cycle II based upon the success of the Juvenile Hall project. Similarly, the Youth Camp will need sufficient computer systems, along with staff development, to implement the program.

The Regional Occupational Program prepares students for entry-level positions in industry, where computer awareness is becoming one of the qualifications for employment. The current use of computers within the Regional Occupational Program is limited to two courses: Electronics and Word Processing/Office Skills. Advisory committees of the other ROP courses have requested that we consider computerizing their programs. In fact, the computer revolution has affected all the programs in which ROP offers training.

A needs assessment was made during a computer in-service program through the TEC centers this past year. It indicated that students who have qualified in computer skills through our Electronics and Word Processing/Office Skills programs gained employment sooner and were paid at a higher rate than students in our other programs. Within the next three years, ROP would like to computerize its remaining 14 programs. This next year, teachers will be in-serviced in computer techniques and have a review of the software needs for their particular programs. The Advisory Committee for Retail Merchandising has suggested that students gain computer competency in order to qualify for entry-level employment in the next two years and have authorized purchase of computers to enhance employment opportunities and to improve basic math skills.

Severely Emotionally Disturbed Special Day Classes

Site: Windsor Class Center

Age/Number: 24 secondary and 24 elementary students

Existing Technology: One Apple computer and minimal software

Curriculum/Instruction Priorities:
Awareness
Responsibility
Training
Application
Computer application to data base

Student Development Needs:
Awareness
Basic Instruction
Application
Curriculum
Programming

Staff Development Needs:
Awareness
Basic Instruction
Application
Curriculum
Programming

Site: Amado Inc.

Age/Number: Ten secondary students

Existing Technology:
One each, Apple and Commodore computers plus minimal software

Curriculum/Instruction Priorities: Typing, phonic decoding, math facts

Students Development Needs: Continuing

Staff Development Needs:
Awareness
Basic Instruction
Application
Curriculum
Programming

Site: CDTC

Age/Number: 24 elementary students

Existing Technology: None

Curriculum/Instruction Priorities: Typing, phonic decoding, math facts

Student Development Needs: Continue

Staff Development Needs:
Awareness
Basic Instruction
Application
Curriculum
Programming

Site: New Directions

Age/Numbers: 24 secondary students

Existing Technology: One Apple computer and minimal software

Curriculum/Instruction Priorities: Typing, phonic decoding, math facts

Student Development Needs: Continue

Staff Development Needs:
Awareness
Basic Instr.
Application
Curriculum
Programming

Site: Family Life Center

Age/Number: 40 secondary students (two sites)

Existing Technology:
One each, Apple and Commodore computers plus minimal software

Curriculum/Instruction Priorities: Typing, phonic decoding, math facts

Student Development Needs: Continue

Staff Development Needs:
Awareness
Basic Instruction
Application
Curriculum
Programming

Three-Year Plan

1984–85 Goals

1. Complete software and hardware inventory.

2. Offer initial staff development activities in computer literacy.

3. Establish SCOE computer committee to provide leadership and direction for the computer plan.

4. Adopt an SCOE computer education plan.

5. Conduct a needs assessment of school programs for logical and critical thinking skills.

6. Create a circulating software library for use by Sonoma County School programs.

1985–86 Goals

1. Complete staff computer skills assessment.

2. Provide staff development activities for all curriculum areas.

3. Identify model computer programs in the county.

4. Coordinate plan with county school districts.

5. Assess future software/hardware needs.

6. Establish policies for hardware and software acquisition.

7. Update software/hardware inventory and library.

8. Develop evaluation procedures for computer committee.

9. Evaluate computer education goals and revise plan as necessary.

1986–87 Goals

1. Provide staff with training in appropriate areas.

2. Assess the status of computer education in school programs operated by SCOE.

3. Review and evaluate computer goals and plans.

4. Review need for software library of commercial and public domain.

5. Assess development of programs for teaching logical and critical thinking skills.

6. Write course goals and student expectancies for computer applications in targeted vocational areas.

Program Evaluation

1. Evaluation plans will be cooperatively developed between the Computer Education Committee and each school program as represented by the principal of the program.

2. Program evaluation will include the gathering of specific data such as teacher observation, student use of computers (time and quality), and student outcomes.

3. Data will be analyzed and presented by the committee for use in program decision making.

Sonoma County Office of Education
Computer Software Copyright Policy

Walter A. Eagan, Ed. D., Superintendent

County Administration Center
Room 111–E, 410 Fiscal Drive
Santa Rosa, CA 94501

Dick Bacon, Associate Superintendent

It is the intent of the Sonoma County Office of Education to adhere to the provisions of copyright laws that apply to microcomputer software. Although there continues to be controversy regarding interpretation of those copyright laws, the following procedures represent a sincere effort to operate legally. The Sonoma County Office of Education recognizes that computer copyright laws contribute to increased costs and reduce incentives for the development of good educational software. These conditions are detrimental to the development of effective educational uses of microcomputers. Therefore, in an effort to discourage violation of copyright laws and to prevent such illegal activities from occurring in facilities and with equipment under the control of SCOE:

1. Sonoma County Office of Education employees will be expected to adhere to the provisions of Public Law 96-517, Section 10 (b) which amends Section 117 of Title 17 of the United States Code to allow for the making of backup copies of computer programs. This states law that:

"...it is not an infringement for the owner of a copy of a computer program to make or authorize the making of another copy or adaptation of that computer program provided:

a. that such new copy or adaptation is created as an essential step in the utilization of the computer program in conjunction with a machine and that it is used in no other matter.

b. that such a new copy and adaptation is for archival purposes only and that all archival copies are destroyed in the event that continued possession of the computer program should cease to be rightful.

2. When software is to be used on a disk-sharing system, efforts will be made to secure this software from copying.

3. The Sonoma County Office of Education will not allow illegal copies of copyrighted computer software to be made or used on its equipment.

4. The Sonoma County Office of Education will require individuals reviewing software to sign a statement that they agree to follow the conditions of this policy.

5. The Sonoma County Office of Education will not extend the services of the SCOE Microcomputer Software Library to persons who have been determined to have violated any of the provisions of this policy.

6. The principal (program manager) of each school program is responsible for establishing practices that will enforce this policy.

Telephone: (707)527-2527

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District Level Plans

Computer Science Education
Palo Alto Unified School District

Goal of Computer Science Education

The overall goal of the PAUSD educational plan is to infuse into the lives of the district's K–12 clients every computer-related experience possible. These experiences need to be consistent with the responsibilities of a modern school district and appropriate to the current and predictable needs of its students.

Nancy Palmer
Program Supervisor Computer Education

Computer Education
25 Churchill
Palo Alto, CA 94306
(415) 329-3778

Program Description

The Palo Alto computer science education program is intended for grades K–12.

In grades K–6, the use of the computer is a part of the normal school activities. Students receive direct instruction by the classroom teacher or other staff members and use available software to develop initial knowledge and skills, reinforce previous learnings, and enrich academic areas.

In the Middle School, all seventh grade students participate in a Computer Awareness Unit. Elective course offerings (Computer 11 and 12) include the use of simulations, data management, word processing, and spreadsheet software. Students are introduced to programming structure and techniques through LOGO and BASIC. In addition, the Computer Labs are available on a drop-in basis and for independent study and peer/computer tutoring. Finally, computers on carts are brought to the classrooms where students have the opportunity to use the software and/or develop programs related to classwork.

In grades 9–12 it is recommended that all students, unless a student demonstrates proficiency in computer studies or has passed an equivalent course prior to attending high school, enroll for one quarter in a Computer Studies course. Electives in programming languages, problem solving, and business education using the computer are offered.

Summer sessions, for students of all grade levels, offer exploration and in-depth instruction in computer applications and programming languages. For K–3, math exploration, problem-solving, and computer exploration using LOGO are available. At the middle elementary school level, 4–6, LOGO and BASIC are taught with an expanded program that includes word processing and math skills. High school sessions focus on BASIC and Pascal programming languages, graphics and plotters, keyboarding and word processing. SAT preparation software materials are available to students who are enrolled in the course for reinforcement and enrichment.

Elementary and Middle School Computer Curriculum

Computer Concepts

Integration of Computers into Daily Life	Social Effect of Computers in Silicon Valley	Historical Development of Computers	Logic	Vocabulary of Common Terms and Names	Future Development of Computers
Identify where computers are found in everyday life.	Identify relatives and neighbors who work in computer-related businesses. Identify the geographical area called Silicon Valley.	Identify some inventors and computing devices which were precursors of the microcomputer.	N/A	Recognize words describing computer parts and functions.	Identify the major contributions of computers to American culture. Identify possible broad scenarios for short-term, next developments.
Identify jobs and professions using computers and explain the use of computers in those fields.	Gain an awareness of the impact of the computer industry on everyday life.	Develop an understanding of the scope of the history of computing machines.	Use programs which require conclusions based on logical deduction. Use programs with instructions deleted so that the purpose of the exercise must be deduced.	Demonstrate fluency in using computer terms when describing hardware and software.	Apply simple futuristic conceptual thinking in developing both short- and long-term scenarios for the role of computers in the technology of the United States.
Project the future uses of computers and robotics.	Create a report (using a word processing program) on some aspect of the impact of Silicon Valley developments on the local society.	Describe the historical sequence of the inventors and inventions which preceded the "technological revolution."	Use standard flowchart symbols to show how a task is broken up into integral parts and movements before it becomes programmable. Create a computer program.	Express technical and programming ideas using the appropriate computer words.	Apply futuristic conceptual thinking for the development of computers in the future of mankind.

Computer Skills

K–3

Keyboard Use: Recognize location of letters and numerals. Understand use of special keys.

Use of Prepared Programs: Follow directions for working with different programs. Be able to use menu-driven disks.

Use of Hardware and Software: Use the computer and disk drive properly. Treat software in an ethical manner.

Identify Parts of the Computer: Name some of the parts of the computer and its peripheral equipment.

Programming: N/A

Read Manuals and Specifications: Follow simple directions from manuals to get a program started. Select programs from a menu.

Select Hardware and Software: N/A

4–6

Keyboard Use: Locate keys to input words. Demonstrate awareness of proper typing skills while at keyboard.

Use of Prepared Programs: Load and use programs from disks without menus. Create a graphics display using LOGO. Follow directions for working with applications programs.

Use of Hardware and Software: Alter and copy only those programs for which there is permission. Demonstrate proper use of the printer.

Identify Parts of the Computer: Identify and describe the use of some of the internal parts of the computer. Use the correct technical terms when describing the computer.

Programming: Explain the concept of programming. Develop a two-step program using LOGO or BASIC.

Read Manuals and Specifications: Follow reference manuals to use programs and all subroutines of the programs.

Select Hardware and Software: Identify the major factors in selection of hardware and software.

7–8

Keyboard Use: Create a report card using a word processing program.

Use of Prepared Programs: Use commands in programs to create original programs. Create a report using a word processing program.

Use of Hardware and Software: Respect the rights of users and programmers when sharing lab facilities.

Identify Parts of the Computer: N/A

Programming: Write programs using text and graphics to accomplish a specific task. Modify existing programs.

Read Manuals and Specifications:
Read and understand manuals with more complex specifications.

Select Hardware and Software
Consider pros and cons on selection of hardware and software.

Science Education Curriculum
Computer Concepts

Computer Science Education

K-3

Computer Skill: Use the keyboard.

Student Goal(s): To recognize the location of letters and numerals and understand the use of the special keys.
Experience(s): Routine classroom use of computer-assisted instruction
Software Materials: Introduction to the Keyboard MECC Vols. 1, 2, 4, 5, 7, 11, 12, Bumble's Puzzle, Gertrude's Secret, Moptown Hotel.
Supplemental Materials: Posters

Computer Skill: Use prepared programs.

Student Goal(s): To follow directions for working with different programs—simulations, drill exercises, and problem-solving. To demonstrate successful use of menu-driven disks, changing from program to program.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Use of computer hardware and software.

Student Goal(s): To demonstrate, with minimal supervision, the ability to use the computer and disk drive properly. To treat software in an ethical manner (getting permission to copy a program). To handle software carefully and correctly.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Identification of parts of the computer:

Student Goal(s): To name correctly some of the parts of the computer and its peripheral equipment and explain their use (keyboard, monitor, drive, diskette, computer, printer).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Ability to read manuals and specifications.

Student Goal(s): To follow simple written and/or graphic directions from a manual or chart to get a program started.
Experience: Routine classroom use of computer-assisted instruction.

Computer Concept: Integration of computers into daily life.

Student Goal(s): To identify places where computers are found in everyday life (such as offices, department stores, grocery stores, restaurants, and banks).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Social Effect of Computers in Silicon Valley

Student Goal(s): To identify relatives and neighbors who work in computer-related businesses (including research, manufacturing, marketing, telecommunications). To identify the geographical area called Silicon Valley.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Historical development of computers.

Student Goal(s): To identify inventors and the computing devices which were precursors of the microcomputer.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Vocabulary of Common Terms and Names

Student Goal(s): To recognize words describing computer parts and functions (such as computer, monitor, drive, software, load, boot up)
Experience(s): Routine classroom use of computer-assisted instruction

Computer Concept: Future Development of Computers:

Student Goal(s): To identify the major contribution of computers to American culture. To identify possible broad scenarios for short-term, next developments.
Experience(s): Routine classroom use of computer-assisted instruction.

4-6

Computer Skill: Keyboard Use

Student Goal(s): To locate keys to input words. To exhibit an awareness of proper typing skills while at the keyboard (that is, the importance of hand and finger placement in reaching keys)
Experience(s): Routine classroom use of computer-assisted instruction. Independent use of the computer. Exploration in typing.
Software Materials: Introduction to the Keyboard and Typing Tutor.
Supplemental Materials: Keyboard chart.

Computer Skill: Use of Prepared Programs

Student Goal(s):
To load and use programs from disks without menus, including DOS and utilities programs. To create a graphics display while using a program such as LOGO. To follow directions for working with application programs (such as word processing program).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Use of Computer Hardware and Software

Student Goal(s): To alter and/or copy only those programs for which there is permission. To demonstrate proper use of the printer.
Experiences(s): Classroom demonstrations, Routine classroom use of computer-assisted instruction.

Computer Skill: Identification of Parts of the Computer

Student Goal(s): To identify and describe the functions of some of the internal parts of the computer (such as controller card, motherboard, circuit board, slots). To use the correct technical terms when describing the computer .
Experience(s): Visual and hands-on examination of the microcomputer. Routine classroom use of computer-assisted instruction.

Computer Skill: Programming

Student Goal(s): To explain the concept of programming (identifying a problem, figuring out the steps needed to solve the problem, coding the sequence of steps, reworking and correcting problems in a program). To develop a two-step program using LOGO or BASIC (a list of instructions that the computer carries out one at a time).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Ability to Read Manuals and Specifications

Student Goal(s): To follow reference manuals (with minimal consultation) when using programs and all subroutines within programs.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Ability to Select Hardware and Software

Student Goal(s): To identify the major factors that need to be considered when selecting computer equipment and software (identify primary users, intended use, price range, and so on)
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Integration of Computers into Daily Life

Student Goal(s): To identify jobs and professions using computers and explain the use of computers by workers in those fields (such as newspaper reporters, reporters, travel agents, farmers, office workers).
Experience(s): Visitors/guest speakers from the work world. Routine classroom use of computer-assisted instruction.

Computer Concept: Social Effect of Computers in Silicon Valley

Student Goal(s): To develop an understanding of the scope of the history of computing machines.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Logic

Student Goal(s): To explain the basic operation of the sequence of events within a computer. To describe how information is processed. To use programs which require conclusions based on logical deductions. To use programs with instructions deleted so that the purpose of the exercise must be deduced.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Vocabulary of Common Terms and Names

Student Goal(s): To demonstrate fluency in using computer terms when describing hardware and software (including chips, CPU, menu, catalog).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Future Development of Computers

Student Goal(s): To apply simple futuristic conceptual thinking in developing both short and long-term scenarios for the role of computers in the technology of the United States (such as electronic mail and banking, degree-day information in agriculture)
Experience(s): Routine classroom use of computer-assisted intruction.

7–8

Computer Skill: Keyboard Use

Student Goal(s): To create a report using a word processing program
Experience(s): Computer Awareness Unit, routine classroom use of computer-assisted intruction, Computer II, Independent Study, Typing.
Software Materials: AppleWriter II, Bank Street Writer, PFS Write.

Computer Skill: Use of Prepared Programs

Student Goal(s): To respect the rights of other users and programmers when sharing computer lab facilities (for example, sharing time at the computer, accessing and altering only your own programs from a group diskette).
Experience(s): Computer Awareness Unit, routine classroom use of computer-assisted intruction, Computer II, Independent Study.

Computer Skill: Programming

Student Goal(s): To create programs using text and graphics to accomplish a specific task.
Experience(s): To modify existing programs, Computer Awareness Unit, Computer II, Independent Study.

Computer Skill: Ability to Read Manuals and Specifications

Student Goal(s): To read and understand manuals and more complex specifications on computer programs and equipment.
Experience(s): Computer II, Independent Study.

Computer Skill: Ability to Select Hardware and Software

Student Goal(s): To consider the pros and cons on selection of hardware and software, including such factors as costs in relation to utility, and long-term value.
Experience(s): Computer II, Independent Study.

Computer Skill: Integration of Computers into Daily Life

Student Goal(s): To project the future uses of computer and robotics (that is, artificial intelligence, factory robots).
Experience(s): Computer Awareness Unit, Social Studies, Computer II, Independent Study.

Computer Concept: Social Effect of Computers in Silicon Valley

Student Goal(s): To create a report, using a word processing program, on some aspect of the impact of Silicon Valley developments on the local society.
Experience(s): Computer II, English, Social Studies, Independent Study.

Computer Concept: Historical Development of Computers

Student Goal(s): To describe the historical sequence of the inventors and inventions which preceded the "technological revolution" taking place in the late twentieth century.
Experience(s): Computer II, Social Studies, Independent Study

Computer Concept: Logic

Student Goal(s): To express technical and programming ideas using the appropriate vocabulary.
Experience(s): Computer II, Independent Study

Computer Concept: Vocabulary of Common Terms and Names

Student Goal(s): To express technical and programming ideas using the appropriate vocabulary.
Experience(s): Computer II, Independent Study.

Computer Concept: Future Development of Computers

Student Goal(s): To apply futuristic conceptual thinking for the development of computers in the future of mankind.
Experience(s): Social Studies, Computer Awareness Unit, Computer II, Independent Study

Extended/Independent Study

Extended/Independent Study is offered to Middle School students in several ways:
1. After negotiating a contract among the classroom teacher(s), parent(s), and student, students are released from class one or more periods weekly to explore computer programming and computer applications. The contract is usually for a length of approximately 8 sessions (8 weeks). A student tutor works with one or two students and instructs the learners in computer programming in BASIC.

2. Students meet individually or in small groups (6 to 8 students) during regularly scheduled class periods to receive instruction in word processing and/or computer applications relevant to the course of study.

3. While serving as teacher's aides, students assist other students and pursue individual interests in computer applications and programming.

4. Before and after school, students have the opportunity to work independently on class work and areas of interest.

Course Description

Course Title: Computer 12.
Department(s): Computer Science Division.
Course Length: 1 semester.
Grade Level(s): 7 and 8.
Recommended Preparation: Computer 11, Keyboarding highly recommended.
Instructional Goals: To extend and sharpen the student's programming skills. To learn about the wide variety of computer applications.
Course Content: Extension of programming techniques including
- Efficiency of programming
- File creation and manipulation
- High-resolution graphics
- Use of word processing
- Use of spreadsheet software
- Use of elementary data management software

Course Description

Course Title: Computer 11.
Department(s): Computer Science Division.
Course Length: 1 semester.
Grade Level(s): 7 and 8.
Recommended Preparation: Keyboarding highly recommended.
Instructional Goals: To communicate with the computer through programming languages. To recognize the value of the computer in problem solving. To learn about the wide variety of computer applications.
Course Content: Computer awareness, including such topics as history, uses, vocational and career opportunities, how computers work, and ethical issues in computer use.

Programming in LOGO
Primitive commands
Figures and designs
Debugging
Procedures
Editing
Saving to disk
Variable inputs

Problem Solving in LOGO
Debugging existing programs
Planning, creating, debugging original programs
Procedural thinking
Generalizing strategies
Predicting results

Programming in BASIC
Numeric and string variables
Exponential notation
Formatting
Order of precedence of operators
Subroutines
Data, variables, arrays
Statements
Counters and accumulators
Random number generators
Saving and editing programs
Loops and branching
Debugging

Low-resolution graphics
Commands
For-Next loops
Plotting
Combining graphics with text
Use of simulations for problem solving and exploration

Course Description

Course Title: Computer 12.
Department(s): Computer Science Division.
Course Length: 1 semester.
Grade Level(s): 7 and 8.
Recommended Preparation: Computer 11, Keyboarding highly recommended.
Instructional Goals: To extend and sharpen the student's programming skills, to learn about the wide variety of computer applications.

Course Content: Extension of programming techniques including:
Efficiency of programming
File creation and manipulation
High-resolution graphics
Use of word processing
Use of spreadsheet software
Use of elementary data mangement software

Computer Awareness Unit
7th Grade Science Students

Description: The Computer Awareness Unit is a one week mini-course presented by the Computer Education Coordinator and the Instructional Computer Services Specialist. Seventh grade science students and their teachers participate in the course, which is conducted in the Middle School Computer Lab.

Goals and Objectives:
1. To introduce all seventh grade students to the computer lab and encourage the use of the lab for all subjects and programming.
2. To expose students to present and future uses they might make of computers.
3. To introduce students to word processing, graphics and LOGO.
4. To reduce bewilderment and fear of current technology and promote a balanced view of the computer's role in society.

Computer Awareness Curriculum:
First day—historical development of computers, uses of computers in society, introduction to the keyboard.
Second day —introduction to BASIC.
Third day—introduction to LOGO and Graphics.
Fourth day—introduction to word processing and educational Software.

High School Course Offerings

Title	Department	Length/Credit	Grades	Preparation	Content
Computer Studies.	Computer Science.	1 quarter/2.5 units	9–12.	Keyboarding.	Computer awareness, introduction to language, software, simulations, word processing, spreadsheet.
Typing/Keyboarding word processing.	Business Education.	1–4 semesters/ variable.	9-12.	None.	Develop skill in typing rapidly and accurately at both the typewriter and computer, tabulations, business letters, footnotes, grammar, and punctuation.
Computer-Assisited Accounting.	Business Education.	Year/5–21 units.	9–12.	Basic arithmetic skills.	Complete accounting cycle using double-entry system, accounting computer program used upon completion of basic theory. Spreadsheet.
Beginning Programming.	Computer Science Division.	1 semester/5 units.	9–12.	Computer Studies, Keyboarding.	Beginning skills of programming in Basic or Pascal, flowcharting, program design.
Computer Math.	Mathematics.	1 semester/5 units.	10–11–12.	Algebra, Beginning Programming, Keyboarding.	Math problems from algebra, geometry, trigonometry, calculus and statistics, programming in Advanced BASIC and PASCAL.
PASCAL Programming.	Computer Science Division.	1 semester/5 units.	10–11–12.	One year algebra.	Computer awareness, introroduction to language, software, simulations, word processing, spreadsheet.
Computer Science AP.	Computer Science Division.	Year/10 units 11, 12.	11–12.	Math 2H or 3A.	See advanced placement computer science outline, structured programming in PASCAL, files, data types, sorting, searching, and other algorithms.
Independent Study.	Computer Science Division.	Variable/contract.	9–12.	None.	Study and preparation for advanced placement, more advanced programming language study.

Skills Applications

Subject	Use
Science.	Predictions, calculations, simulations.
Social Studies.	Simulations, word processing.
Math.	Drill and practice reinforcement, calculations, Problemsolving.
English.	Vocabulary, grammar, word processing.
Business Education.	Data/word processing.
Art.	Line drawing, graphics.
Music.	Composition theory, note drill.
Practical Arts.	Typing skills, design, angles.
Home Economics.	Metric measurement, nutrition.
Foreign Language.	Vocabulary, culture, grammar, linguistic patterns.
Reading Lab.	SAT preparation, reading.
Computer Lab.	Drill and Practice programming, exploration, word processing, reinforcement.

High School Course Offerings and Related Studies

Course Title: Typing/Keyboarding/Word Processing (Computer–Typewriter).
Department(s): Business Education.
Course Length: 1 to 4 semesters.
Credits: Variable to 20.
Grade Level(s): 9, 10, 11, 12.
Recommended Preparation: None.
Prerequisites: Previous development of skills will determine placement.

Four semesters of typing are available. Variable credit is given. Students will be placed within the program according to their competence. Completion of the program should lead to sufficient proficiency for personal and career expectations.

Instructional Goals
Keyboarding (all students):
1. To gain rhythmic stroking of the keyboard, using designated fingers with correct positioning of body, arms, hands, and fingers, so they can relax and realize their ultimate potential.

2. To develop quick finger response to copy they are reading by typing patterns, phrases, sentences, and paragraphs having similar letter patterns; then progressing to more difficult copy.

Word Processing:
3. To learn to center copy of varying lengths, to tabulate, write business and personal letters properly positioned on the page, and to type manuscripts with footnotes. Students will work from arranged and unarranged copy.

4. To type at an average of 30 to 40 gross words a minute with no more than one error per minute on three- to five-minute timings.

5. To provide students with sufficient experience in typing for personal use and at the same time provide a basis for career use.

Advanced Skills:
6. Definitely vocational in nature. Stress is placed upon production typing of representative business problems. Skill is developed in turning out error-free work. Students will learn to use the microcomputer to edit text. Most work will be done from unarranged rough drafts.

Students will use both the microcomputer and the typewriter at all levels of proficiency. The greatest emphasis will be placed on computer usage.

1. To develop skillful techniques in typing rapidly and accurately, using the touch system methodically with efficient work habits. To develop mastery of the keyboard and a working knowledge of all needed operative parts of the typewriter and microcomputer.

2. To develop skill in vertical and horizontal methods of centering columnar reports and typewritten copy on paper of varying sizes.

3. To develop adeptness in positioning and typing envelopes, well-centered letters, business forms, and manuscripts with footnotes.

4. To complement punctuation and grammar rules, stress work division, gain improvement in spelling, and expand the typist's vocabulary.

5. To develop speed and accuracy in taking timed writings.

Course Description

Course Title: Computer-assited Accounting.
Department(s): Business Education.
Course Length: Year.
Credits: 10 (variable).
Grade Level(s): 9, 10, 11, 12.
Recommended Preparation: Basic arithmetic skills.
Instructional Goals: To acquaint students with a systematic method of setting up and keeping financial records for business or personal use.
To prepare students for entry-level positions in the business community.
To prepare students for future accounting classes in college.
To make students computer literate in the general field of accounting.
Course Content: A double-entry system of accounting is used.

This course covers the complete accounting cycle emphasizing good work habits, neatness, and accuracy.

The student will first learn a systematic method for making journal entries, posting to ledgers, preparing trial balances, preparing financial statements, and adjusting and closing books. Students will use practical workbooks, worksheets, and other business forms such as invoices, bank deposit slips, checks, credit memoranda, and cash receipts. The computer will be used to facilitate the processing of this data.

Computer Application: Accounting applications on the computer will begin with the trial balance, income statement and balance sheet. Spreadsheet may be used for some portions of the accounting program. A full-scale accounting computer program will be used upon completion of basic accounting theory. Report writing using the microcomputer will be included for advanced-level students.

Course Description

Course Title: Beginning Programming.
Department(s): Computer Science Division.
Course Length: 1 semester.
Credits: 5 units.
Grade Level(s): 9, 10, 11, 12.
Recommended Preparation: Computer Studies or equivalent, Keyboarding highly recommended.
Instructional Goals: To teach the student the beginning skills of computer programming, to have students debug and run their programs on a computer.
Course Content:
Simple flowcharting
Design of a computer program
Language structure and use, such as BASIC, or Pascal
Numeric and string variables
Mathematical operations
Statements
Functions, formatting, subroutines
Looping
Disk operation
Loading, running and saving programs
Output devices

Course Description:

Course Title: Computer Mathematics.
Course Length: 1 semester.
Credits: 5 units.
Grade Level(s): 10, 11, 12.
Recommended: One year of algebra, one year of geometry, beginning programming or equivalent, keyboarding.
Instructional Goals: To extend and sharpen the student's programming skills as well as mastering the computer as a tool to solve problems of a mathematical nature.
Course Content: Use of computer to solve mathematical problems chosen from advanced algebra, geometry, trigonometry, calculus, and statistics. Programming in advanced BASIC and/or Pascal.

Course Description:

Course Title: Pascal Programming.
Department(s): Computer Science Division.
Course Length: 1 semester.
Credits: 5 units.
Grade Level(s): 10, 11, 12.
Recommended Preparation: One year of algebra, one year of geometry, beginning programming or equivalent, keyboarding.
Instructional Goals: To extend and sharpen the student's programmimg skills, to include sufficient programming skills for those students who wish to pursue later the requirements of the Advanced Placement curriculum in Computer Science.
Course Content:
Extension of programming techniques including:
Experience in structured programming
Efficiency of programming
File creation and manipulation
Merging of programs
Sorting and other algorithms
Programming in Pascal
Graphics

Course Description:

Course Title: Computer Science AP.
Department(s): Computer Science Division.
Course Length: 1 year.
Credits: 10 units.
Grade Level(s): 11, 12.
Recommended Preparation: Completion of Math 2H, 3A, or above or department approval. Some familiarity with computers/programming is suggested.
Instructional Goals: To provide the student with a course equivalent to the first course in Computer Science at the college level.
Course Content: To follow the outline of the Advanced Placement Computer Science curriculum: designing structured programs using "top-down" and "stepwise refinement" methodically; translating the solution of problems into clearly written programs in Pascal; the study of data types and structures; searching and sorting techniques; the study of algorithms.

Computer Education Foundation Program
Los Angeles Unified School District
Office of Instruction

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I. Introduction

A. The Computer Education Foundation Program for the Los Angeles Unified School District is an extension of the superintendent's position statement regarding computer literacy and the use of computers in instruction. It is based upon the recommendations of Computer Literacy and the Use of Microcomputers in Instruction by Dr. Robert Baker and Dr. James Taylor, presented to the Los Angeles Unified School District Board of Education on August 16, 1984. Computer literacy is defined in that document as having four dimensions:

1. First, there is computer awareness, the understanding of the existence of computers in our society, the use of computers, and the impact of their use upon our daily lives.

2. Second is the dimension of computer knowledge, characterized by comprehension of the history of computers, the evolution of the "generations" of computers, some knowledge of how computers work, and some limited skills in operating a computer.

3. The third dimension is computer competency, which includes expanded skills in computer education, some ability to manage the computer's functions through mastery of one or more computer languages, and a fuller understanding of the capabilities of the computer as a problem-solving tool.

4. The highest dimension of our definition of computer literacy, the fourth dimension, is computer expertise. This expertise can involve those technical skills needed to build and maintain the computer itself, or may focus entirely upon the highly sophisticated skills required to master the tremendous potential of this tool for the expansion of humankind's reservoir of knowledge.

B. Based on these four dimensions, the Baker-Taylor report developed a broad plan of action for a Districtwide computer-supported program. The Computer Education Foundation Program is an implementation plan supported by the recommendations of this report.

This program incorporates the district's Computer Literacy Continuum as well as the goal of integrating the computer, as an instructional tool, into the existing curriculum.

C. The Foundation Program includes the third dimension of computer literacy in the elementary school by teaching the programming language Logo in the fifth grade. It is expected that every student will have access to the Foundation Program in the secondary schools. The program also provides for a grass-roots, in-service training plan by using teachers and coordinators with computer expertise as instructors for targeted staff members who will be directly involved in implementing the program at the school sites.

II. Program Specifications

A. Program Goals

• To achieve student computer literacy and to expand the utilization of microcomputer technology as an instructional support tool in the schools of the Los Angeles Unified School District.

• To provide students with equal access to:
1. Computer hardware.
2. Instruction in computer science.

B. Program Objectives

• All schools, over a three-year period, will participate in an instructional program designed to provide computer literacy instruction for all students.

• All participating students will benefit from the instructional use of computers.

• The Foundation Program will complement the district's instructional guidelines and courses.

Elementary Program
The computer program at the elementary school level will be integrated into the existing Los Angeles Unified School District's curriculum. The program will begin in the fifth grade.

• Logo and word processing will be the emphasis of student instruction. Logo's graphics provide a visual outcome of ideas and experiments by children. Logo provides an environment for the application of many of the curriculum skills identified in the fourth and fifth grade continuum. Logo's editing features provide for the rudiments of word processing. Logo's programming structure provides a problem-solving strategy that can be written in outline form rather than in symbolic flowcharts. Logo may encourage children's critical thinking, assist in the acquisition of basic educational skills, and increase enthusiasm and motivation for learning by providing immediate feedback.

• The elementary program will include the integration of computers into as many subject areas as possible.

• The Foundation Program will also support the instructional program by teaching:
1. Keyboarding skills and use of computer peripherals
2. Skills identified in the Computer Literacy Continuum
3. Visual experiences that enhance the understanding of spatial relationships
4. Problem-solving strategies through writing computer procedures in sequential steps
5. Experience in proofreading, editing, refining, and redesigning computer procedures

• Students will be provided with an opportunity to enrich their studies through participation in after-school computer clubs.

Secondary Program
The program at the secondary level will be derived from the Continuum of Skills. Specific courses are outlined in the District's Guidelines for Instruction, Secondary School Curriculum, 1984 edition.

Junior High/Intermediate Program
- Introduction to Computers (10-week course)—18-01-01
- Introduction to Computers (20-week course)—18-01-03

The decision to offer either a 10-week or a 20-week course is a school programming option.

- Opportunities for expanding skills in computer science beyond the Foundation Program may be fulfilled by the following courses:

1. Computer Programming 1AB 18-02-01, 18-02-02 Annual Course
2. Computer Programming 2AB 18-02-03, 18-02-04 Annual Course
3. Digital Computer Technology 1AB 18-07-01, 18-07-02 Annual Course
4. Information Processing 18-05-01 Semester Course

- Departments should explore opportunities for integration into the existing instructional program.

Instructional guides are available for Introduction to Computers as follows:

10-week course: Publication No. SC-857, 1984, Office of Secondary Instruction
20-week course: Publication No. SC-858, 1984, Office of Secondary Instruction

Senior High Program
- Computer literacy instruction will be offered to all students who have not previously had an opportunity to take such instruction (by school option either the 10-week or 20-week course).

- The high school program should include courses that will build students' expertise in the area of computer science.

These courses should include:

1. Computer Programming 1AB	18-02-01, 18-02-02
2. Computer Programming 2AB	18-02-03, 18-02-04
3. Computer Programming 3AB	18-02-05, 18-02-06
4. AP Computer Science AB	18-02-07, 18-02-08
5. Word Processing	18-04-01
6. Data processing	18-03-01
7. Information Processing	18-05-01
8. Digital Computer Technology 1AB	18-07-01, 18-07-02
9. Digital Computer Technology 2AB	18-07-21, 18-07-22
10. Digital Computer Technology 3AB	18-07-31, 18-07-32

• During the summer, opportunities for acquiring computer competency and expertise will be offered at selected high schools for all students.

• The high school program will include application of computers in as many subjects as possible. The school will be responsible for developing a plan that will assure the use of computers in various subject areas. This school plan should include department meetings and in-service training so as to integrate computer usage as effectively as possible.

Course descriptions and representative objectives are found in Guidelines for Instruction: Computer Science, Publication No. SC-

C. Hardware Requirements

• One computer for each fifth grade class (complete with monitor, information retrieval, and memory sufficient to support software). Thirty microcomputers for each secondary school (complete with monitors, dual disk drives, and memory sufficient to support instructional software—must have 64K minimum).

• Printers will be allocated as follows:

1. Elementary—one printer per school or two for more than five computer stations
2. Secondary—five printers per school

• Computer laboratories should be set up to meet instructional objectives

• Funds have been allocated for alterations and improvement (for example, security and electrical) of computer laboratories

D. Software Requirements

• The District will provide specific software as part of the Foundation Program. District in-service training will include the use and application of this software. All departments should have the opportunity to become aware of it and use it.

• Local schools will have the opportunity to purchase software than meets student needs. A specific amount of money will be allocated for this purpose.

• Each school will be provided with a foundation software package consisting of the following:

1. Elementary—Logo and word processing.

2. Secondary—data base, word processing, spreadsheets, BASIC, Pascal. (Pascal will be provided to senior high schools only.)

E. Demonstration Grants

• The demonstration grants will seek to encourage innovative use of the microcomputer as a classroom instructional resource. They will provide a means by which creative teachers, interested in computer utilization in instruction, may develop new uses of this support resource. The objective during the first year is to encourage use of the microcomputer in the fields not generally associated with computer activity.

• Proposals during the initial year of funding would be limited to the areas of English and Social Studies.

• It should be understood that grants are model applications that the district hopes to see replicated in other schools.

F. Evaluation and Monitoring

• During year one, the evaluation activities will necessarily emphasize the careful monitoring and modification of program implementation procedures. The successful installation of the program, consistent with the program's goals, objectives, and specifications, is of paramount importance if program outcomes are to be achieved.

The District Task Force will develop a plan and framework to assess the effectiveness (self-correcting when necessary) of prespecified activities related to:

1. Task Force functions
2. School selection and orientation
3. Staff training and development
4. Hardware procurement and school installation
5. Instructional software information, access, and development
6. Dissemination of information to parents and community

During the first year, instrumentation will be developed and verified that is sensitive to performance on program outcome indicators.

Four general program outcome areas have been identified as important:

1. Student skills proficiencies
2. Student motivation and productivity
3. Teacher productivity
4. Curricular efficiency

Progress reports will be submitted to the superintendent twice a year.

III. Program Implementation

A. Selection of Schools

• A three-year phase-in: It is suggested that the District's Foundation program be installed in all elementary, junior high, and senior high schools over a three year-period.

• School year 1984–85: Fifteen elementary schools and three junior high intermediate schools from each region should be selected by the region superintendent to begin Foundation Program implementation. In selecting schools, priority consideration shall be given to the following: school staff's willingness to volunteer for participation; Chapter I, PHBAO and year-round schools; schools with existing hardware below foundation program level; and grade level continuity between elementary and secondary.

Each successive year the junior high/intermediate schools would likewise be selected to conform to the elementary feeder schools that enter the program.

• In consultation with the Office of Instruction and appropriate region superintendents, the Senior High Schools Division superintendent will select 16 regular senior high schools for installations during 1984–85. Again, priorities should be given to volunteers requesting participation in the first year activity. The schools selected should represent both those that have developed some computer sophistication and those that have not. Selection consideration should be given to providing progressive continuity for junior high and intermediate school students who have participated in the program.

• School year 1985–86: Approximately 15 to 20 additional elementary schools and approximately three additional junior high/intermediate schools from each region will be selected by the region superintendent to begin Foundation Program implementation in 1985–86. School principals should volunteer for participation. In a similar manner, additional regular senior high schools will be selected for program implementation in 1985–86.

School year 1986–87: All remaining elementary, junior high/intermediate, and regular senior high schools will commence foundation program implementation.

Microcomputers in the Public Schools

A Management Plan

H. Charles Larracey
March 1986

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Based on an extensive review of the literature, this writer has concluded that the essential components of a plan to introduce computers into the public schools include: (1) planning for organization and implementation; (2) curriculum development; (3) staff training; (4) acquisition of hardware and software; and (5) provisions for support services. School leadership personnel must effectively address each of these variable components in order to provide the opportunity for the computer to become a viable tool for both instructional and administrative applications. The computer, unlike other technologies that have been introduced and subsequently rejected, has the potential to improve the teaching and learning process; it has the potential to facilitate learning in the classroom. The computer presents a powerful opportunity for change in public school organizations.

The first part of this paper will outline the direct practical experience that this writer has had in introducing computer technology into the public schools. The second part will outline the essential experiences and review the literature.

Background Information

For the last four years this writer has directed an effort to introduce microcomputers into the seven schools of the Keene (N.H.) School District. Prior to that time the school district management personnel at both the central office and secondary levels did have access to a mainframe computer located at the central office and used exclusively for administrative applications. This school district has an enrollment of 4,100 students with an annual operating budget for the fiscal year 1985–1986 of $14,891,000.

The Keene School District has undertaken a number of initiatives pertaining to the introduction of computers into the schools. These computers have been used in three ways: (1) as an object of study K–12; (2) as an instructional tool in the various content areas; and (3) to improve the productivity and efficiency of teachers and managerial personnel.

The initiatives that have been undertaken include:

- The development of a comprehensive plan for K–12 computer education.

- The development of a K–12 Computer Science Skills Continuum, initially written in 1983 and revised in 1985. The continuum will be rewritten in 1987.

- The purchase of more than 270 microcomputers which are now available for use by instructional staff and students K–12. This represents a student-to-computer ratio of 15:1.

- The development of a centralized process for the evaluation; purchase, cataloging, storage, and distribution of computer software.

- The development of a staff training program designed to address all levels of ability and interest pertaining to the use of the computer in the educational process.

- Direct access to the central office mainframe computer (Digital PD11/44) by the seven schools of the district for automation of student management information, budget development, and other administrative applications.

- Access to software programs for the microcomputer used to computerize the development and revision of the individualized education plans for special education students.

- The employment of a Manager of Instructional Resources and Technology responsible for the coordination of all aspects of the K–12 computer education program (August 1985).

- The establishment of a loan policy for home use of microcomputers by instructional staff during school vacations and summer recess.

- The development of a professional library on the use of computers in education.

- The design and construction of microcomputer laboratories at Franklin Elementary School, Keene Junior High School, and Keene High School.

- The acquisition of a Digital VAX 11/750 minicomputer with more than 40 on-line terminals for instructional use at Keene High School.

- The development and implementation of a number of elective course opportunities for students at Keene High School/Cheshire Vocational Center, and Keene Junior High School (grades 7 and 8).

- Participation by professional staff in numerous national, regional, and state workshops on the use of computers in education.

- The development of a plan that enables school staff to purchase computers and related equipment via payroll deduction.

The Management Plan

This paper will now examine the important elements of the six basic components of a management plan for introducing computer technology into the public schools.

A. Planning for Organization and Implementation

- The central office administration must present a vision for the organization and implementation of computer education for the district.

- A comprehensive plan for computer education should be developed for the school district.

- The plan should articulate a clear philosophical statement on the use of computers in the schools.

- The development of the plan should involve the active participation of all levels of the organization.

- The individual schools should develop a plan that is keyed to the overall district plan.

- A K–12 Computer Education Committee should be appointed to oversee all aspects of computer education for the district and for the individual schools.

- All plans for computer education should be reviewed and revised annually.

- The first step in the development of a plan is to conduct an assessment to determine the extent to which computer hardware and software is currently being used for instructional and administrative applications. The assessment could also be used to identify the type of training programs that personnel in the district have participated in.

- The plan should provide the opportunity for experimentation to occur in the various schools, for example, to determine the best location of computers.

- The plan should attempt to define what computer literacy means; for the student, for the teacher, and for the school administration.

- Once a certain critical mass has been reached, a K–12 coordinator for the program should be appointed.

- The members of the Board of Education must be kept informed of all aspects of the plan. Their continuous support is essential.

- Individual schools should formulate guidelines for student use of microcomputers (covering operating instructions, minimum proficiency requirements, time schedules, and so on). Some schools may award computer operator licenses to students once they have demonstrated a standard of proficiency.

- A set of specifications for the design of microcomputer laboratories should be developed.

- The school library/media centers are an integral (if not central) part of an effective computer education plan.

• The district plan should outline the variety of ways that the computer could be used for instructional and administrative purposes: (such as word processing, test construction, library circulation, accounting, gradebooks, attendance, and classroom demonstrations.)

• Long-range plans should be developed on a 2- to 3-year basis, rather than for a longer duration, because of the rapid rate of technological developments.

B. Curriculum Development

• The school district should develop a K–12 skills continuum for computer science instruction (a skills continuum indentifies the skills to be taught at each grade level).

• The skills continuum should be rewritten every two (2) years in order to maintain pace with technological developments.

• The four key sections of a computer science continuum include computer awareness, computer operations, computer-assisted instruction, and computer prgramming.

• Programs in the elementary schools should not emphasize computer programming.

• The plan for teaching keyboarding skills should be formulated and implemented in the elementary schools.

• Close cooperation among staff in the elementary, junior high, and high school is essential and is key to effective program development and coordination.

• The responsibility for computer science instruction should not be automatically assigned to the mathematics department.

C. Staff Training

• Training programs should initially involve school personnel who are interested in utilizing the computer for instructional or administrative purposes.

• Training programs should address the issues of computerphobia or technophobia.

• Trainers need to be senstive to teacher's and administrator's emotional reactions to the computer and structure the training in a nonthreatening manner.

• Workshops for teachers should concentrate on the use of tools programs, word processors, data bases, spreadsheets, graphic utilities, and the like.

• A training model should include continuous and on-site support for neophyte teachers.

• The training should be practical; it should provide the opportunity for hands-on experience.

• A school district should identify its own system "experts" to run training programs and to be available for follow-up questions or problems.

• The training programs should allow for experimentation and creativity.

• The training programs should promote a positive attitude of working together, of expecting to need help, and of seeking help.

• Training programs for teachers should include such topics as: the advantages and disadvantages of using the computer in the instructional process; the compatibility between doing tasks by computer and using traditional methods; a survey of computer applications in the classroom; the historical development of the computer; understanding the impact the computer can have on the teaching process; and insight into the major problems involved in the integration of computers into education.

• Teacher training programs should not generally emphasize acquisition of programming skills.

• Training programs should provide informal opportunities for personnel to share information.

D. Acquisition of Hardware and Software

• Criteria for the selection of software should be clearly deliniated. Such criteria should include: documentation, instructional objectives, learning objectives, accuracy of content, validation, compatibility to software offered by other vendors, operating costs, copyright, and so on.

• Criteria for the selection of hardware should be clearly identified. Such criteria should include: warranty information, maintenance costs, availability of software, peripherals, vendor assistance, documentation, amount of sales to other districts, training, installation of equipment, and the like.

• The selection of software for computer-assisted instruction should be related to the skills to be taught at the various grade levels and in the K–12 content areas.

• Standardization of equipment allows for an exchange of software among schools and promotes the most effective maintenance arrangements.

• The software should be previewed and evaluated prior to making a decision to purchase.

• A software catalog should be developed at the district level for dissemination to all classroom teachers. This catalog should include a brief description of the software, a rating of the software, and the appropriate grade level for use.

E. Provisions for Support Services

• A professional library of resource information should be created.

• A centralized system for preview, evaluation, purchase, storage, and distribution of computer software should be established.

• A process for the dissemination of information should be established. It is impossible for any one person to devote the time required to keep up with the developments in computers and other technologies.

• Support and encouragement should be provided for the formation of user groups in the local areas.

• A preventative maintenance program should be instituted for all computer and peripheral equipment.

• The school district should develop specific guidelines on copyright information.

• School personnel should be encouraged to participate in local, regional, state, and national conferences on computers in education.

F. Program Evaluation

An essential component of the management plan is a system for continuous evaluation. An evaluation plan should initially focus on such factors as (1) effectiveness of in-service training, in particular, the type of training which seems to be the most effective in empowering the classroom teacher to utilize the microcomputer; (2) the percentage of staff participation in training programs; (3) an assessment of both the availability and utilization of computer hardware and software; (4) a review of the school district's management plan for the introduction to computers in the schools for both administrative and instructional purposes. After a period of 3 to 4 years the evaluation plan should focus on student learning outcomes.

The formative evaluation plan will provide continuous feedback on all aspects of the management plan so that adjustments can readily be made to improve the strategies and approaches utilized in the various schools. The primary objectives of this evaluation component are to provide continuous in-process feedback; to discover unplanned and unexpected consequences that are resulting from particular program practices; to suggest realistic alternative courses of action for program modification; to determine the underlying policies and administrative procedures that contribute to the success or failure of particular components of the plan; and finally, to determine whether or how effectively the objectives of the program are being fulfilled.

All programs need to be evaluated over time in order to gather information on which to base conclusions and make recommendations for change. The ultimate question to be answered is to what extent has the application and utilization of computers interacted with the teaching process to improve student learning.

Computers in the Schools

A Management Plan

DESCRIPTION	1	2	3	4	1	2	3	4	1	2	3	4
Needs assessment: analysis of current use and projection of future use/needs.	●	●										
Selection of K-12 Computer Education Committee.		●	●									
Selection of hardware, development of bid specifications, and selection of vendor.				●	●							
Development of comprehensive computer education plan.			●	●								
Evaluation of software, preview, purchase, storage, cataloging and distribution.				●	●	●	●	●	●	●	●	●
Development of K-12 Computer Science Skills Continum.							●	●				
Appoint district K-12 Computer Education Coordinator.									●			
Training programs for teachers and administrators.			●	●	●	●	●	●	●	●	●	●

Summary

It is this writer's opinion that the most important single element in the successful introduction of computers into the public schools is the classroom teacher. School district leadership personnel must focus on this important person and develop a staff training program that will address the concerns of classroom teachers about this innovation.

To incorporate any new program into an organization successfully requires an effective blending of leadership skills, an appreciation and sensitivity to the process of change, and a knowledge of the elements of the program itself. This careful blending must occur if the program is to become an inherent part of the organization.

Computers in the Schools
A Management Plan

Description

1. Needs assessment: analysis of current use and projection of future use/needs.
2. Selection of K–12 Computer Education Committee.
3. Selection of hardware, development of bid specifications, and selection of vendor.
4. Development of comprehensive computer education plan.
5. Evaluation of software, preview, purchase, storage, cataloging, and distribution.
6. Development of K–12 Computer Science Skills Continuum.
7. Appoint district K–12 Computer Education Coordinator.
8. Training programs for teachers and administrators.

"Do's and Don'ts" of a Computer Education Management Plan:

1. Do remember that the computer is an instructional tool; it is not the instructional tool.
2. Do not force teachers to use the computer as an instructional tool.
3. Do start the plan initially with those teachers who are interested.
4. Teachers on staff are the best resources for trainers in staff development.
5. Do not allow individual schools to go off on their own; a district level framework is essential.
6. Do allow an option on the location of computers in the school; for example, individual classrooms, computer laboratory, or library/media center.
7. The interest and involvement of central office administration will be essential to the success of a computer education plan.
8. Do offer programs for parents in the evening, open houses during the school day or during school vacations.
9. Do keep the school board/committee informed of all activites. Their continued support is essential.
10. Do allow the teachers to experiment; do allow the opportunity for creativity.
11. Do not purchase software without providing the opportunity for previewing and evaluation by at least 3 or 4 classroom teachers.
12. Do standardize equipment purchases, particularly during the early stages of implementing a computer education plan.
13. Do not assume that all teachers will be equally motivated or interested.
14. Do centralize the purchasing of hardware or software. Most companies offer substantial discounts for bulk purchasing.
15. Do not purchase a maintenance contract for all pieces of equipment; the hardware is remarkably trouble free.
16. Do install a security alarm system for all computer laboratories.
17. Do not install carpeting or allow the use of chalk-boards in computer laboratories.
18. Skills in programming the computer should not be emphasized in staff development program.
19. Do remember that computers present a powerful opportunity for change in school organizations.
20. Do remember that change is a process; not an event.
21. Do incorporate in the management plan a public relations component involving the local media. It is essential to keep the community informed.
22. Do allow the use of computer laboratories for evening adult education programs.

School Level Plans

Technology Plan

Cincinnati Country Day School
Cincinnati, Ohio

This document is a tentative technology plan for the next eight to ten years at Cincinnati Country Day School. We are fully aware that because of rapid changes in technology, revisions to this plan may be necessary and desirable.

Throughout the plan the following abbreviations are used: US—Upper School, grades 9—12; LS—Lower School, grades pre—Kindergarten to 5; MS—Middle School, grades 6—8; WP—Word Processing; DB—Data Base.

In the Computer Science column, the breakup reflects the fact that computer development was handled by the Physics department until 1980, by the Math department from 1980 to 1982, and after 1982, as a separate department.

In subject-area columns, the asterisks represent estimates of the amount of computer usage in that particular discipline at the time.

Now moving into its fourth generation of computer hardware, Cincinnati Country Day School is firmly committed to remaining a leader in computer education. Though we intend to support our aging Apple II family as long and as richly as possible, our future clearly belongs with the Macintosh. We have been involved with Macintoshes for two years, and fully expect all academic areas (not just math and science) to make optimum use of this new user-friendly environment to enrich their disciplines.

	Hardware	Software	Staff Development	Curriculum	Computer Science	Math	Science	History English	Language	Music Art Drama
1970	2 Terminals, Outside Host	Inhouse Developed Science Oriented	Computer Developed Director Named (David E. Laird)	BASIC & Fortran Independent		■	■■■			
				Astronomy & Physics Projects		■■	Projects ■■■■■			
			Inservice Courses				Interfacing			
1975	HP 2000 inhouse 16 Terminals on Campus Time Share Host	Inhouse HP Canned	Text in BASIC			■■	■■■■■■■			
						■■	■■■■■■■			
			Memorial Laird Funds Supports Hardware/ Staff/Curriculum Development	Middle School Requiremdnt BASIC Course (1982)		■■				
1980	6 Apples 3 Pets	$3K/year Commercial Apple					■■■■■■■		■	
	17 Apples Classroom Big Screening Computer Lab 300 Baud Moden	The Sourse Compuserve Dow Jones			1983	■■■ ■■■ ■■■		Word Processing	■	
	Lower School Apples 37 Apple Total		Sabbatical Program Tumolo-Degree Teacher Apple Purchases Inservice Programs		Computer Department Formed	■■	■	■	■	
	5 Macintoshes (1984)	Beta Test Sites MacPascal Macintosh Basic	Summer Projects Courses		Keyboarding Lower School	■■	■■	■		
			Intern Programs	Electronic Bullitin Board	Logo Grade 4 BASIC Middle School	■■	■■■	■■	■	
1985						■■■	■■■	■■■		■■■■■■
	Applelink Account		Salaried .5 Technician	Computer Required Keyboard Requirements Lower School	BASIC 1&2 Upper School Pascal APCS (84)	■■■	■■■■	Electronic Bullitin Board		Theatergames
	Word Processing Lab In Upper Schools Online Search Capabilities	Partnerships with Software Companies In Development	Salaried .5 Lower School Coordinator			■■■■	Interfacing ■■■■	■■■■■■■	■■■■	■■■■■■■
					Assembly	■■■■■	■■■■■■	■■■■■■ Word Processing Lab	■■■■	Mac Paint Course
			Word Processing Lab	English Department Word Processing			Lab Stations ■■■■■■	Data Base Work		■■■■■■■ Art Stations Synthesizer
1990	20 Mac Pluses in Upper School MacLab, FileServer, HDisk Laserwriter Applelab, network,HDisk Lower School Lab (25 Macs)		Salaried .5 Manager		Lisp	■■■■■■■ Classroom Stations		■■■■■■■		Music Composition Class
			Full Salaried Technician	History Department Data Base			■■■■■■■			■■■■■■■
			Degreed Department Head			■■■■■■■	■■■■■■■	Reading Progrms	Voice Programs	■■■■■■■
	Lower School Word Processing & Keyboard Lab						■■■■■■■	Required Research Papers	■■■■■■■	
	Classroom Demo Stations			Continuing Education by Modem		■■■■■■■	■■■■■■■			HiResolution Color Art Stations
	Satellite Hookup, Classroom Connection						■■■■■■■	Classroom Stations	■■■■■■■	■■■■■■■

Bibliography

Computer Applications Planning, California State Department of Education, Sacramento, Calif., 1985.

Computer Applications Planning: A Notebook for Trainers and Consultants, Merrimack Education Center, Chelmsford, Mass., 1985.

Computer Applications Planning: A Template for Preparing a Technology Applications Plan, Merrimack Education Center, Chelmsford, Mass., 1985.

Computers in Education: Goals and Content, California State Department of Education, Sacramento, Calif., 1985.

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